THE PRESERVATION SOCIETY OF NEWPORT COUNTY

WHITE PAPER
Implementation of a Ground-Source Geothermal System at The Breakers for Dehumidification to Protect Collections

By Christopher Daly, Director of Properties & Patricia Miller, Chief Conservator

The project was to implement a modular, ground-source geothermal system to moderate high relative humidity during the humid months at The Breakers (1895), a historic house museum in Newport, Rhode Island, which is owned and operated by the Preservation Society of Newport County. The primary objective was to safeguard a humanities collection important to interpretation of national trends during the late 19th and early 20th centuries. Additional significant outcomes included a reduction in fuel costs, which supports the Preservation Society's commitment to green solutions to sustainability, and increased comfort for the staff and the more than 450,000 visitors from all over the United States and 114 foreign countries who visit The Breakers each year.

A National Historic Landmark designed by Richard Morris Hunt for Cornelius Vanderbilt II in 1893 and completed in 1895, The Breakers, its collections, and its inhabitants represent the pinnacle of Gilded Age architectural, cultural, and social ambition. The historic integrity of The Breakers—whose 3,000 objects are 99 percent original to the house—offers the visitor and scholar an authentic experience of the period and is a rich source for research into such topics as the history of architecture and interior design in America; servant life during a time of widespread social change; the role of women in creative place making; the public's enduring fascination with wealth; and the tensions that rise when unfettered privilege appears to threaten the American Dream of equality. But The Breakers endures an ocean side environment with cold, alternately dry and humid winters and hot humid summers. Many of the important architectural surfaces and movable collections within The Breakers are fragile, and extreme fluctuations of relative humidity in particular were threatening the delicate architectural treatments and important fine and decorative arts objects.

The result of more than ten years' planning, this project addressed the Preservation Society's primary mission to "protect, preserve, and present an exceptional collection of house museums and landscapes" in Newport, Rhode Island, one of the most historically intact cities in the country; and a priority goal of the Preservation Society's Long-Range Collections Preservation Plan. A planning grant in 2009 from the NEH: Sustaining Cultural and Heritage Collections paid for a feasibility study that set the stage for the design; and a grant from the Loebs Family Foundation paid for creation of the design and a pilot project that successfully tested the viability of the system. (See NEH White Paper (PF-50079): "Feasibility Study for the Use of Geothermal Climate Modification at The Breakers," submitted July 2011.)

MAJOR ACTIVITIES

Installation of the geothermal system was originally scheduled to begin in the spring of 2016. However, the project began behind schedule due to key staff changes, vendor change, and delays in completing the Section 106 process.

Key Staff Changes

Charles J. Moore, chief conservator and co-project director, retired in June 2015, shortly before the award was made. Curt Genga, director of properties, who was previously co-project director, became the sole project director. Although they had served as co-directors, Mr. Moore had been the initiator and driving force behind the project, involved both from the technical and the conservation point of view. He wrote the two proposals to NEH for the feasibility study and the implementation, as well as the final report and White Paper for the feasibility study. Patricia Miller, the current chief conservator, replaced Mr. Moore and has continued to be involved in the project for matters directly relating to the collections conservation, but not in the technical aspects of the system itself. Mr. Moore's departure inevitably led to a delay in the project start, as Mr. Genga had to incorporate the project into his already significant work duties. Mr. Genga subsequently retired before the system had been fully installed and the project period ended. When the new director of properties, Christopher Daly, took over in October 2017, the exterior geothermal wells were drilled and the refrigerant tubes run but none of the mechanical systems were installed. Mr. Daly led the project to completion, but the staff change inevitably resulted in additional delays.

Vendor Change

For installation of the system, Mr. Genga decided to switch to a vendor with more extensive experience installing geothermal HVAC system, Lawrence Air Systems, Inc. This change necessitated a revision to the budget to reflect their bid-for-work and to include electrical costs, which were not included in the original budget submitted to NEH.

Section 106 Review

In February 2016, the Preservation Society submitted proposed plans for The Breakers geothermal system to the Rhode Island Historical Preservation and Heritage Commission (RIHPHC) for review in accordance with the Section 106 process. RIHPHC's review revealed that there was overlap between the design for the well installations and a previously approved cultural landscape plan. The project team subsequently modified the well installation plan and submitted a new proposal in June to RIHPHC for review. The following month, after a site visit, RIHPHC provided the NEH a written determination that the proposed project would have no adverse effect on The Breakers property. In September, consulting parties were notified and a public notice was posted on the Preservation Society's website. The thirty-day public comment period came to a close in October and the Section 106 Review was completed in our favor by letter dated November 7, 2016 from the Rhode Island Historical Preservation & Heritage Commission to Cathleen Tefft at NEH, concurring that "the undertaking will have no adverse effect on historic properties." At the same time, the Preservation

Society submitted a request to extend the award period from December 31, 2016 to December 31, 2017, which was approved by NEH Official Notice of Action on December 21, 2016.

During the Section 106 process, we reexamined the original work schedule and revised it so that the project was phased into segments that could be more easily funded and completed:

- Phase 1: Install exterior geothermal ground loops
- Phase 2: Purchase geothermal heat pumps, hydronic air handler systems, & assemblies
- Phase 3: Install geothermal heat pumps & hydronic air handler systems
- Phase 4: Install Unico inverter heat pump systems in kitchen & mezzanine

Installation of the System (March 2017 – July 2018)
Once the danger of significant winter weather had passed, we scheduled Lawrence Air Systems to begin Phase 1 work. On March 1, 2017, we submitted a request for advancement of the entire NEH award of $300,000 to apply toward the Phase 1 total cost of $302,502. Work proceeded as follows:

PHASE 1: Installation of Geothermal Ground Loops (March – April 2016)
75 100-feet deep holes were drilled into the lawn at The Breakers and 75 Earthlinked copper ground loop assemblies and thermal grouting installed; and 15 manifold sets were brazed and tested. Note: The original system design was a “chilled water” system requiring 96 wells; during the Section 106 review process, the design was changed to be a “direct exchange” system, which is a more streamlined process requiring only 75 wells, a more economical alternative.

PHASE 2: Purchase 15 Geothermal Heat Pumps, Hydronic Air Handler Systems, and Assemblies (June – July 2016)
Prior to purchasing equipment, we conducted final review of interior unit locations in order to optimize functionality of equipment and minimize intrusion relative to basement wall penetrations and obstructions in normal use of basement. Equipment access was also factored into the review. Geothermal heat pumps and air handlers were delivered in July 2016.

Between 2016 and 2017, we performed extensive restorations of the original historic boiler room, tunnel, and basement areas in order to open a new, guided tour for visitors called “Beneath The Breakers.” The tour explores the basement and the original technology of the period (heating. electrical, plumbing, mechanical), and therefore heat pump and air handler locations needed to be sensitively located so as not to impede the tour route.

PHASE 3: Install Geothermal Heat Pumps and Hydronic Air Handler Systems (August 2017 – July 2018)
Design and installation began in August 2017; by July 2018 all work on the base system had been completed. This included:

- Installation of the refrigeration piping under the terrace;

- 15 geothermal heat pumps in place, completely piped, and charged with refrigerant;
- 15 air handlers in place, ducted into the subbasement, and completely ducted to their corresponding airshafts; and
- All conduit and related electrical panels and systems installed.

System start up, testing, and optimization (August – September 2018)
As the building has been its own ecosystem, living and breathing and expanding and contracting in tune with the natural ebbs-and-flows of the exterior environment (temperature and humidity) for the last 123 years, we had wanted to conduct the system start-up in a very slow, methodical and thoughtful way. We were concerned that rapid alterations to the interior humidity and temperature could result in "shocking" the collections and interior finishes, which could cause checking and flaking. Consequently, we slowly began the system start-up with just a few of the units at a time, lowering the relative humidity very gradually so that the interior objects and finishes had a transitional period of adjustment from which we could monitor the effects in small increments of time.

The building had previously relied primarily on the principal of convection in which air heated by radiators inside the 60 vertical shafts that were part of the original structure rose upwards in a continuous flow. Then, as the air cooled and became denser, it dropped and re-circulated back down through alternate return shafts. The system was supplemented with fresh air from outside which was supplied year-round though very large exterior openings under the east terrace and entered through the basement, as heat loss and its associated costs were not thought to be a constraint or concern at the time of the original design. This was akin to leaving barn doors open in the winter. Closing off and sealing the building for the first time ever in order to allow the geothermal system to work properly was a fundamental change to how the building had operated for 123 years.

Throughout this period, we also performed multiple tests, balancing, and system upgrades and adjustments to optimize the performance of the system. These included the addition of desuperheaters, whereby a closed-loop water system was added as a system performance upgrade to remove an additional 40-50 degrees of heat from the circulating refrigerant prior to being pumped back into the ground while in cooling mode. Desuperheating makes the system more efficient because it can perform heat transfer faster, at a lower temperature gradient and resulting pressures. This consequently lowers the operational costs because the ground is not required to absorb as much heat, so the whole heat transfer process can happen more quickly and efficiently.

<u>PHASE 4: 2 Install Unico Inverter Heat Pump Systems in Kitchen and Mezzanine (to be done)</u>
Phase 4 activities have not begun. They will consist of:

- Implementation of various supplemental heating and cooling systems in the house for areas that the geothermal system wasn't designed to address. These spaces include the original kitchen and butler's pantry on the 1st floor, as well as the surveillance area and staff support spaces on the mezzanine level.

- Re-zoning the existing radiant heating system so that it can work simultaneously and in-concert with the geothermal system, providing heat to areas that were outside the parameters of the geothermal systems design.

OUTCOMES AND EVALUATION

The primary objective of this project was to mitigate interior climate at The Breakers in order to reduce deterioration of the historic collections, which are 99 percent original to the house. Overall, the project has been deemed by all to be a huge success on many levels and metrics. As hoped and intended, it has solved or at least mitigated many of the risks related to the long-term exposure of humidity on the collections and highly decorative interior surfaces, and as an added benefit provided air-conditioning and heating to the museum spaces which increased the comfort for our visitors and staff.

Utilizing PEM2 data loggers placed in strategic locations throughout the house, conservation staff recorded temperature and humidity as the system was turned on and adjusted. Data was used to advise the contractors on adjustments needed to prevent problems associated with condensation and other climate-related shocks to the collections and architectural finishes. An immediate positive change in the climate of the building was observed after the system was fully functioning. Temperatures leveled with minimal fluctuation (60-72 degrees over a 3 month period) and regulation of high humidity levels slowly improved with adjustment of set points. Rapid and drastic swings in temperature and humidity (i.e., 25 percent RH over a 4-hour period), which were common in summer months when the building was opened allowing outside air to enter, were no longer regularly observed in the data. Other damaging conditions, such as condensation on historic surfaces like wooden handrails and marble surfaces, were also largely eliminated.

Achieving a 'purpose built museum' climate in a historic building such as The Breakers is not possible; however, we have seen significant improvements in the ability of the system to maintain a more appropriate humidity range for collections (set point 55 percent, actual recorded median range 56-61 percent over a 3 month period) and we continue to make slight adjustments with the help of the data. Although we have only three months of data for analysis (late summer to early winter), we continue to evaluate and make recommendations for improvement of the system to respond to the needs of the collection.

The Breakers attracts more than 450,000 visitors annually from all over the United States and abroad who come to view this largely intact historic property for an authentic experience of the Gilded Age. These include cultural tourists ranging from older adults to families with children to students; and specialists such as art and social historians, connoisseurs, preservationists, architects, conservationists, and craftsmen. In addition, the Preservation Society regularly opens the collections to specialists from such institutions as the Victorian Society Summer School, Sotheby's Education, and the Winterthur American Studies Program, to study The Breakers in depth with Preservation

Society curatorial and conservation staffs, who provide expertise and supervised access to collections. Thanks to the geothermal system, visitors and scholars can now view and study The Breakers in greater comfort, especially during the humid summer months, and they can look forward their children and their grandchildren being able to enjoy and learn from the collections, which are now more fully protected from environmental effects.

Evaluation

A major goal of this project was to mitigate interior RH fluctuations at The Breakers in order to significantly slow-down deterioration of the collections. We have installed three types of systems for ongoing monitoring of temperature and humidity:

1. Sensors installed throughout the first and second floor monitor the individual zones and deliver information to the basement unit thermostats. Remotely enabled thermostats allow staff to monitor both the temperature and humidity of the spaces so that we can make informed decisions and adjustments in real-time from a desktop application. However, these sensors are installed for optimal performance of the system and do not provide data equivalent to what is needed to monitor for collections.

2. Strategically placed PEM2 data loggers remain the primary method of tracking conditions near the most sensitive collections and architectural finishes. Conservation relies on this data to detect microclimate issues that require correction. Prior to the system installation, seven PEM2s tracked areas over two floors. Three additional PEM2s were installed since the system came online. Unfortunately, data from the PEM2 series that we currently use must be manually downloaded from each unit. Our collection manager and IT manager are evaluating WIFI enabled data loggers that can also provide data remotely. (See Attachment A – Climate Comparison Reports.)

3. An Aprilaire system by Research Products, Inc., which allow Preservation staff to monitor the functioning of the geothermal system. Diagnostic modules connected directly on each of the 15 individual units allow us to monitor the operational performance of each, and the system sends an email to critical team members when a system component has been inactive or non-performing for any extended period of time. Each unit has been labeled and associated with the actual rooms and spaces that it serves, so we immediately know which room or areas of the house may be having issues.

A second significant goal was to reduce heating oil consumption at The Breakers, in fulfillment of part an organization-wide effort to reduce our dependence on fossil fuels. As we have not yet gone through a full heating season and have only data for a portion of the year, there is insufficient information on energy consumption and the comparative ratios of heating oil and electricity usage and their associated costs for a true year-long bench-marking of the energy consumption by the system. By summer 2019, we will have a fuller set of bench-marking metadata to make informed decisions and statements about the actual performance of the system.

Challenges

As mentioned previously, overall the project and the installation was a resounding success by all internal metrics thus far. However several challenges did come up over the course of the project. Some challenges were inherent with the transitioning of the internal team, from older team members to new, and the handing off of historical knowledge and the previous planning on the project. The primary impact of these staff changes was delays in implementation of the project, requiring us to submit a request to extend the project period by one year and to delay the final report deadline by close to an additional year when we would have more data to report (both requests were granted by NEH).

Other challenges were handled through team meetings with both internal team staff and external engineers and design consultants, in order to work collaboratively toward a solution. As we have many diverse stakeholders who work and interact with the building differently, each brought a unique perspective and optics to the project. Challenges addressed included;

1. Containing the conditioned air from the geothermal system and isolating it from both the outside air (temperature and humidity) as well as other adjacent non-conditioned spaces within the house has been among our biggest challenges, as the system was only designed for the "museum" spaces of the house. The building also has many non-museum spaces, some of which have supplemental HVAC systems and some of which have none. We are currently handling this with a series of approaches, including the addition of "air curtains" at the transitional areas where there are open doors to the exterior with extensive visitor traffic in and out, and also at the rear staircase, where conditioned air meets non-conditioned air. The air curtains provide a vertical wall of fast-moving tempered air, which creates a more energy-efficient separation of spaces. We have also constructed a temporary fire-retardant plastic partition at the top of the main staircase to keep conditioned air from escaping into the 3rd floor, which is currently an unoccupied non-museum space.

2. Another problem is that the building also has multiple heating and cooling systems already, so integrating the geothermal system into the house in a holistic way presented a series of challenges, some of which we've addressed and some remaining to be addressed. The primary problem is that the vertical shafts that are the pathway for the air delivery of the geothermal system were, and sometimes still are, the same pathway for the previous radiant heating system, which still serves to heat portions of the house that the geothermal system wasn't designed to address. Separating these two systems to work cooperatively and interdependently is tricky because the building's radiant heating system was, and is still, currently on only one zone. This problem is just now becoming most evident in the winter during the heating season, in that the one-and-only thermostat in the building for the

radiation system is currently on the 1st floor in the breakfast room, which is an area serviced by the geothermal system. Consequently, when the geothermal system is operable it "satisfies" the temperature requirements and parameters for the radiant system's thermostat, which thinks all is well and that all spaces are heated appropriately, when in truth spaces outside of the geothermal systems purview and heated only by the existing radiators may be cold. These are among the issues that will be dealt with in Phase 4.

3. One of the beauties of the project is that it was a supreme example of adaptive reuse, whereby many of the existing vertical shafts that previously supplied heated air via radiant convection to the various rooms and areas of the house was also the pathway for providing the conditioned air from the geothermal system. Not considered in the original plan was that when air delivery went from a non-pressurized, naturally ventilated convection system to a pressurized, forced-air (geothermal) system, the shafts would have to be cleaned (vacuumed) from the accumulation of over 100 years of dust. Neglecting to thoroughly clean the shafts would have resulted in dust being blown quickly and ruinously all over the collections the instant the system went live. Fortunately, we were able to anticipate this problem before putting the system on line; however, cleaning turned out to be a somewhat complex and costly task, which was unanticipated in the original project plan and budget.

4. The actual volume and speed of the newly pressurized air coming from the vents as a result of the geothermal system was not anticipated with regards to the original vent locations and the placement of historic collections. As the units were turned on and tested, all collections were moved away from the direct air flow. Once the units achieved optimum air flow, the protection of collections such as furniture and drapery needed to be addressed. Objects cannot simply be removed or relocated as their positioning is important to the historic interpretation of the rooms. Staff is in the process of designing and fabricating diverters to direct the air coming from the vents to protect sensitive surface finishes of the architecture, furniture and textiles. This has proved to be extremely challenging with regards to furniture that was originally affixed directly over or in front of heat vents. Until these diverters are in place, some collections have been temporarily removed from display.

5. Our initial goal was to stabilize temperature and humidity in the house as a means of long-term preservation of the collections and architectural finishes. Original set points were provided in the summer months when the system was turned on: 67-72 degrees, 55 percent RH). The humidity set point is the overriding parameter. When the humidity increases, the system adjusts temperature to regulate and reduce humidity within a range of 3 degrees above or below the temperature set point. This is mostly successful. However, the system is not equipped to add or supply humidity. As we move into the winter months, we will continue to monitor how the system responds with calls for heat, which in the past has resulted in extremely low humidity. Conservation will continue to monitor both climate and collections and target issues for improvement.

Continuation of the Project

As mentioned previously, the geothermal system currently serves only the spaces that were defined as "museum spaces" at the start of the project, which included only the 1st and 2nd floors. Since that time, the previously occupied 3rd floor has become vacant and uninhabited from domestic use for the first time in 123 years. However, this floor still holds a number of collections objects, including original furniture and textiles. Preliminary assessments and studies are being initiated to determine both the condition of the architectural elements and possible future uses but at this time it is not entirely clear how this space may be used and if this space might also be converted into additional museum space. What is clear, however, is that this space will need to be better integrated into the building's overall HVAC systems as it is currently functioning in isolation. The geothermal system may be a prime candidate for future upgrades and expansion here.

Long Term Impact

The successful implementation of The Breakers geothermal also informs our long-range plans to implement climate mitigation systems at our other historic properties. Previously, in addition to The Breakers, we have implemented successful geothermal systems at Chepstow (1860) and The Elms Carriage House (1901). Although at this time there are no firm plans to do another geothermal installation immediately, we are currently soliciting geothermal cost proposals for Rosecliff (1902). This property displays historic collections and is also used extensively for entertaining large groups of people. In 2015, the second floor was converted for use as an exhibition space, which required the gallery rooms to be partitioned from the rest of the house and an independent climate control system installed to meet the facility requirements of lending institutions. However, the remainder of the house continues on a traditional system for climate management (gas heat and air conditioning). In addition to the need to stabilize the interior environment for the collections and architectural finishes, this house also experiences a huge heat live-load from large groups of people who are there simultaneously for weddings and events, which results in a large AC load and cooling demand, so this house would be the next logical prime candidate for geothermal consideration. Similar to The Breakers, this house also sits on a large property with a lot of real estate, which lends itself to drilling the required wells for a geothermal field (either vertically or horizontally).

PUBLICITY

The Preservation Society has used multiple, existing communications tools to publicize the project. These include regular updates on the project through an e-newsletter sent to 40,000 member households and community partners, postings on Facebook, and press releases submitted to local media outlets.

In 2015, William Adams, former chairman of the NEH announced the award at a press conference held in Newport, Rhode Island, stating "We're very proud of this grant. It's a small piece of an ongoing conservation project for the Preservation Society and the entire community." The story was carried by the *Newport Daily News* (see Attachment B: Publicity).

This past fall 2018, we distributed a press release to a wide variety of stakeholders, including press outlets (local and regional), Rhode Island state and federal representatives, state agencies (Department of Environmental Management, Coastal Resources Management Corporation, etc.), environmental organizations (Nature Conservancy, RI Chapter of the US Green Building Council, EcoRI, etc.), local colleges and universities, and more.

The system has been featured in *Antiques and the Arts Weekly,* the *Newport Daily News, EcoRI News,* and the *Providence Business News* (see Attachment B: Publicity). The geothermal system—and the "Beneath the Breakers" tour—were featured in the November 18, 2018 "Net Zero Blanket" episode of PBS's "This Old House," providing exposure to more than 2 million viewers.

The system is featured in our guided tour, "Beneath the Breakers," which takes guests through the underground mechanical and industrial spaces of the building. Since launching in January 2017, 24,551 people have taken the tour.

The annual meeting of American Institute for Conservation will be held in the New England region in 2019. The Preservation Society's conservation staff is currently organizing a two-day group tour of five of our properties with meeting director Ruth Seyler, which will include a presentation on the adaptation of the geothermal system to The Breakers and discussion regarding collections care challenges throughout the process.

ATTACHMENT A

Climate Comparison Reports

IPI Preservation Metrics™ and Statistical Summary

Sorted by: Location name, ascending

Location Dataset	Date Range	Natural Aging	Mechanical Damage	Metal Corrosion	Mold Risk	T°F	%RH	DP°F	TWPI	%DC Max	%EMC Min	%EMC Max	MRF
Breakers- Dining Room	2017-09-01 to 2017-11-30	RISK	RISK	RISK	RISK	67.7	68	56.7	26	0.89	11.3	14.5	1.37
Breakers- Guest Room #10	2017-09-01 to 2017-11-30	RISK	RISK	RISK	RISK	69.3	65	56.6	25	0.94	10.3	13.6	1.28
Breakers- Ladies Reception Room	2017-09-01 to 2017-11-30	RISK	OK	RISK	GOOD	71	57	54.7	27	0.79	8.9	11.8	0.38
Breakers- Library	2017-09-01 to 2017-11-30	RISK	RISK	RISK	RISK	70.5	61	56.1	25	0.97	9.4	12.9	1.02
Breakers- Mr. Vanderbilt's bedroom	2017-09-01 to 2017-11-30	RISK	RISK	RISK	RISK	69.9	62	55.7	26	0.8	9.8	12.7	1.05
Breakers- Mrs. Vanderbilt's bathroom	2017-09-01 to 2017-11-30	RISK	RISK	RISK	RISK	70.1	62	56.1	26	0.76	9.9	12.7	1.01
Breakers- Mrs. Vanderbilt's bedroom	2017-09-01 to 2017-11-30	RISK	RISK	RISK	RISK	71.4	62	57.1	24	0.86	9.5	12.6	0.88
Average (7 locations)						70	62.4	56.1	25.6	0.9	9.9	13	1

IPI Preservation Metrics™ and Statistical Summary

Sorted by: Location name, ascending

Location Dataset	Date Range	Natural Aging	Mechanical Damage	Metal Corrosion	Mold Risk	T°F	%RH	DP°F	TWPI	%DC Max	%EMC Min	%EMC Max	MRF
Breakers- Dining Room	2018-09-01 to 2018-11-30	RISK	RISK	RISK	GOOD	67.1	60	52.7	34	0.71	10.2	12.7	0.2
Breakers- Guest Room #10	2018-09-01 to 2018-11-30	RISK	RISK	RISK	RISK	70.4	57	54.1	27	1.21	8.7	13.1	0.51
Breakers- Ladies Reception Room	2018-09-01 to 2018-11-30	RISK	OK	RISK	GOOD	69.3	55	52	32	0.78	8.8	11.6	0.05
Breakers- Library	2018-09-01 to 2018-11-30	RISK	OK	RISK	GOOD	68.5	57	52.6	32	0.71	9.5	12	0.04
Breakers- Mr. Vanderbilt's bedroom	2018-09-01 to 2018-11-30	RISK	OK	RISK	GOOD	70.7	55	53.6	29	0.73	9.1	11.8	0.1
Breakers- Mrs. Vanderbilt's bathroom	2018-09-01 to 2018-11-30	RISK	RISK	RISK	GOOD	68.4	60	53.8	30	1	9.6	13.2	0.44
Breakers- Mrs. Vanderbilt's bedroom	2018-09-01 to 2018-11-30	RISK	OK	RISK	GOOD	69	59	53.9	30	0.74	9.8	12.5	0.13
Average (7 locations)						69.1	57.6	53.2	30.6	0.8	9.4	12.4	0.21

Breakers- Dining Room

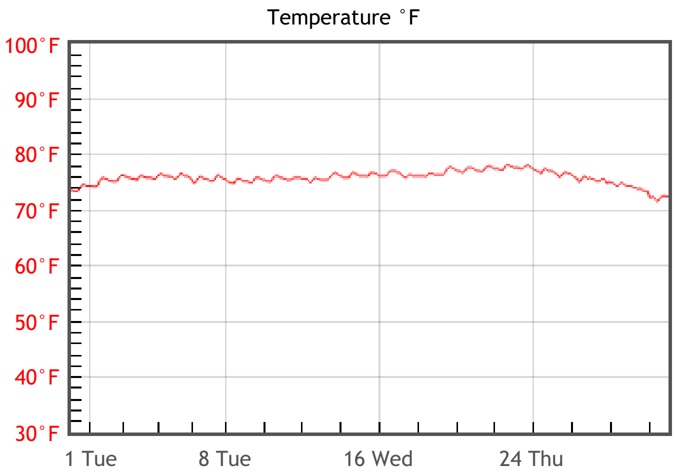
The Preservation Society of Newport County

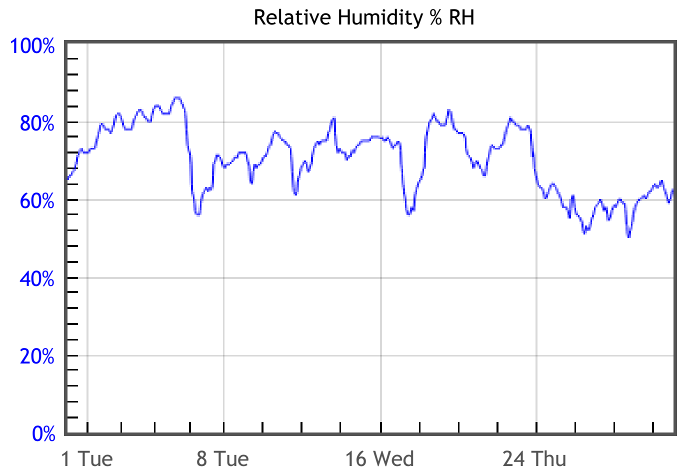
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 14	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.07 % EMC min = 13 % EMC max = 13.3	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 0.91	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 13.3	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	75.9	**%RH Mean**	70	**DP°F Mean**	65.3
T°F Median	75.9	**%RH Median**	72	**DP°F Median**	66.1
T°F Stdev	1.2	**%RH Stdev**	9	**DP°F Stdev**	4.1
T°F Min	71.6	**%RH Min**	50	**DP°F Min**	54.5
T°F Max	78.2	**%RH Max**	86	**DP°F Max**	72.3

Breakers- Guest Room #10

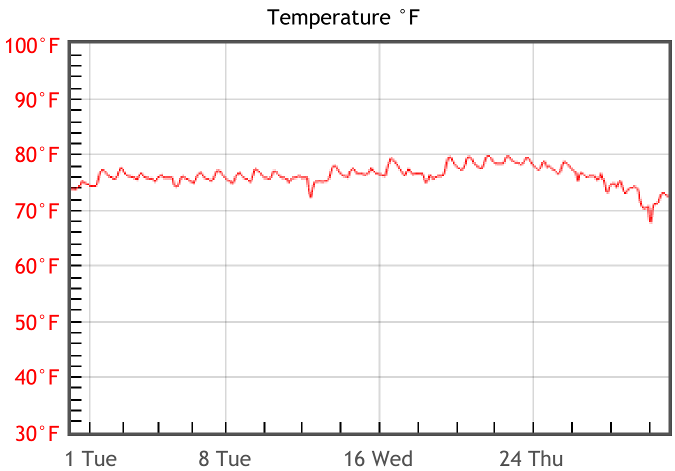
The Preservation Society of Newport County

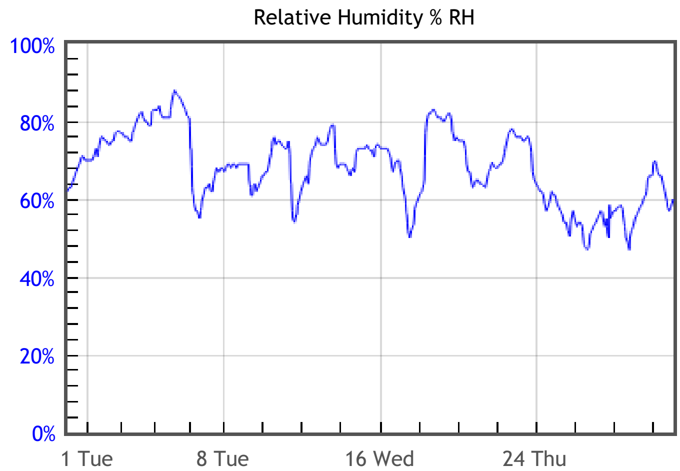
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 14	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.01 % EMC min = 12.6 % EMC max = 12.6	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 0.73	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.6	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	76.2	**%RH Mean**	68	**DP°F Mean**	64.7
T°F Median	76.2	**%RH Median**	69	**DP°F Median**	65.4
T°F Stdev	1.8	**%RH Stdev**	9	**DP°F Stdev**	4.5
T°F Min	67.6	**%RH Min**	46	**DP°F Min**	51.7
T°F Max	79.8	**%RH Max**	88	**DP°F Max**	73.7

Breakers- Ladies Reception Room

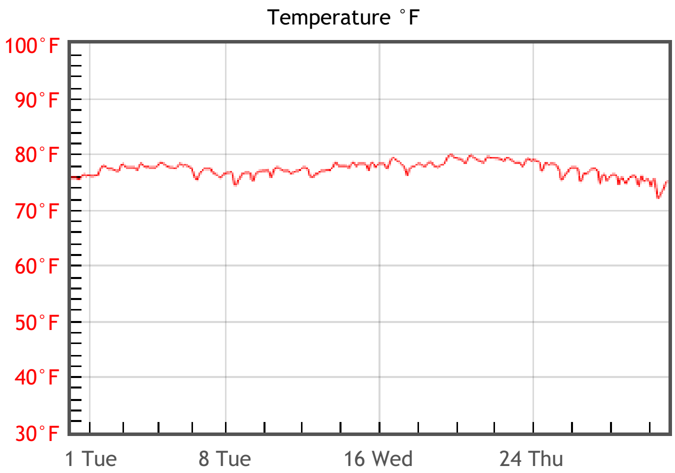
The Preservation Society of Newport County

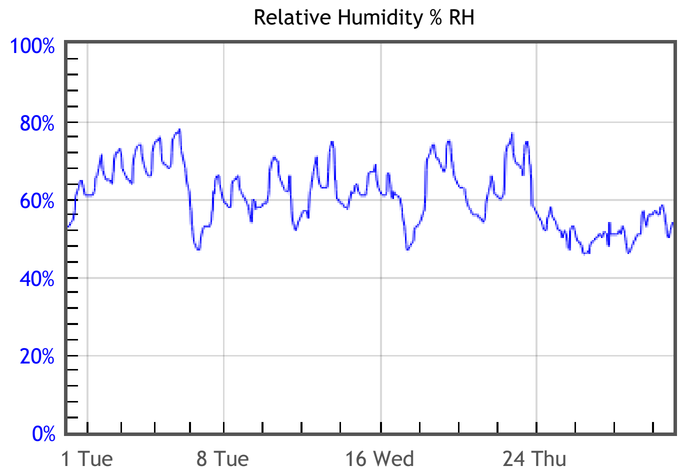
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 16	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0.01 % EMC min = 11.1 % EMC max = 11.1	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.1	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 11.1	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	77.4	**%RH Mean**	61	**DP°F Mean**	62.6
T°F Median	77.7	**%RH Median**	61	**DP°F Median**	62.7
T°F Stdev	1.3	**%RH Stdev**	8	**DP°F Stdev**	4.3
T°F Min	72.1	**%RH Min**	45	**DP°F Min**	52.2
T°F Max	80.2	**%RH Max**	78	**DP°F Max**	71.4

Breakers- Library

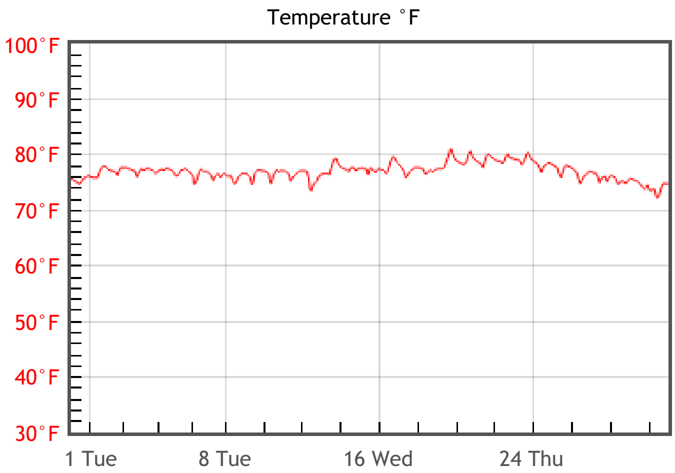
The Preservation Society of Newport County

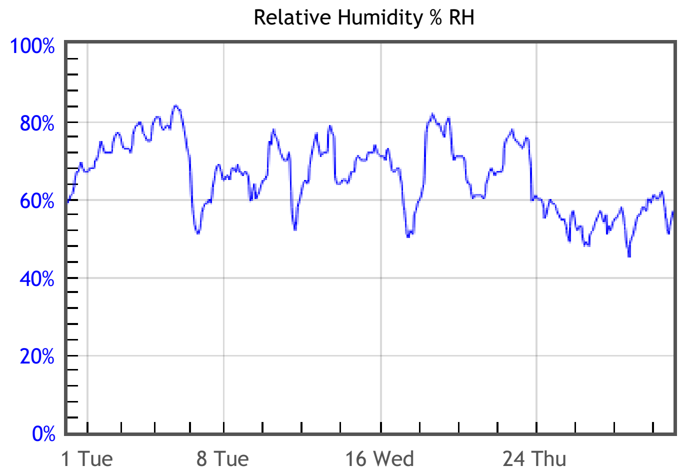
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 14	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0.01 % EMC min = 12.1 % EMC max = 12.1	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.46	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.1	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	77	**%RH Mean**	66	**DP°F Mean**	64.6
T°F Median	77.1	**%RH Median**	67	**DP°F Median**	64.8
T°F Stdev	1.5	**%RH Stdev**	9	**DP°F Stdev**	4.6
T°F Min	72.1	**%RH Min**	45	**DP°F Min**	52.2
T°F Max	81.1	**%RH Max**	84	**DP°F Max**	73.3

Breakers- Mr. Vanderbilt's bedroom

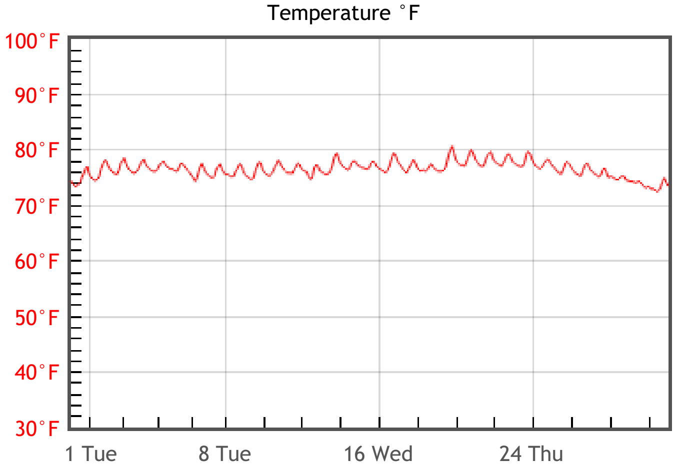
The Preservation Society of Newport County

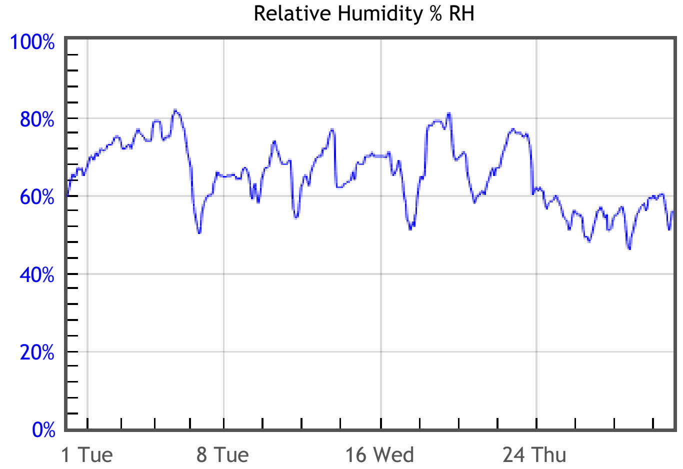
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 15	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0.06 % EMC min = 11.9 % EMC max = 12.1	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.33	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.1	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	76.5	**%RH Mean**	65	**DP°F Mean**	63.9
T°F Median	76.6	**%RH Median**	66	**DP°F Median**	64.1
T°F Stdev	1.4	**%RH Stdev**	8	**DP°F Stdev**	4.3
T°F Min	72.5	**%RH Min**	46	**DP°F Min**	52.6
T°F Max	80.7	**%RH Max**	82	**DP°F Max**	72.5

Breakers- Mrs. Vanderbilt's bathroom

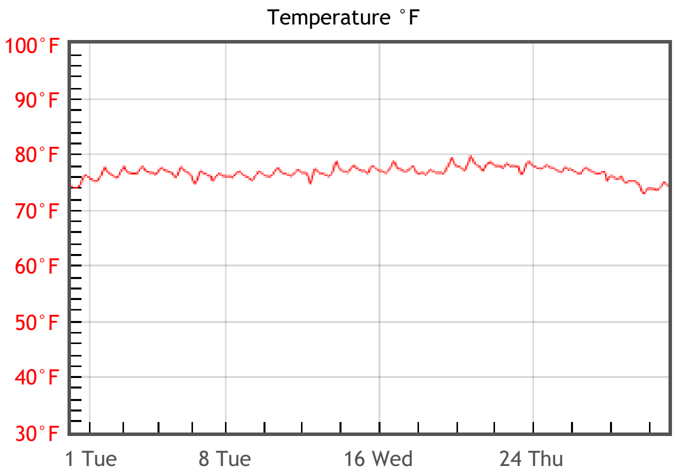
The Preservation Society of Newport County

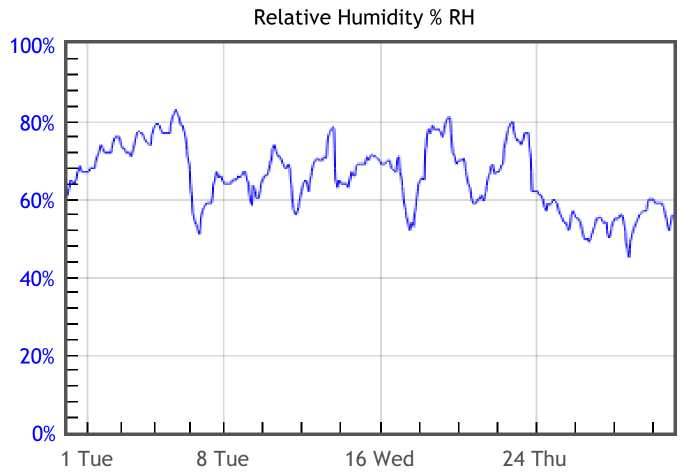
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 15	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0.01 % EMC min = 12.1 % EMC max = 12.1	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.37	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.1	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	76.8	**%RH Mean**	66	**DP°F Mean**	64.2
T°F Median	76.8	**%RH Median**	66	**DP°F Median**	64.4
T°F Stdev	1.1	**%RH Stdev**	8	**DP°F Stdev**	4.1
T°F Min	73	**%RH Min**	45	**DP°F Min**	52.4
T°F Max	79.8	**%RH Max**	83	**DP°F Max**	72.1

Breakers- Mrs. Vanderbilt's bedroom

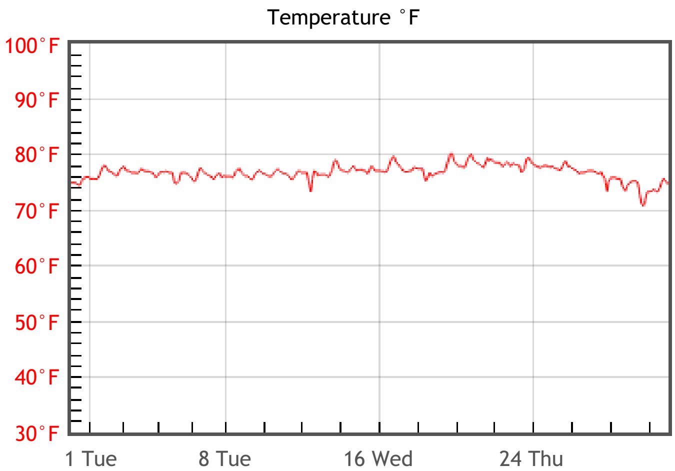
The Preservation Society of Newport County

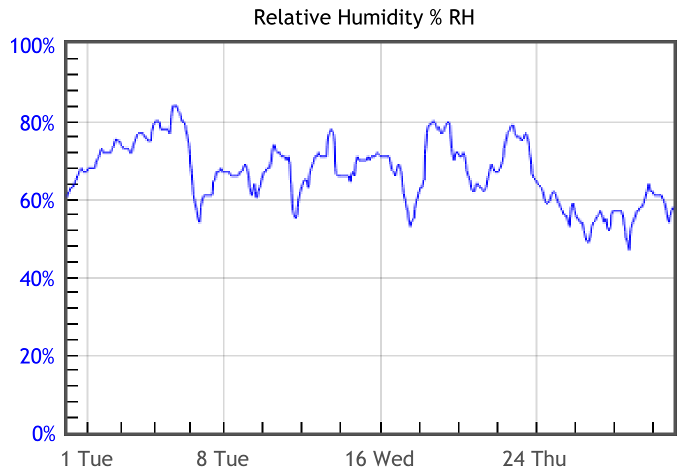
2017-07-31 to 2017-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 14	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 12.3 % EMC max = 12.3	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.42	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.3	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	76.8	**%RH Mean**	67	**DP°F Mean**	64.7
T°F Median	76.8	**%RH Median**	67	**DP°F Median**	65.2
T°F Stdev	1.4	**%RH Stdev**	8	**DP°F Stdev**	3.9
T°F Min	70.8	**%RH Min**	47	**DP°F Min**	52.2
T°F Max	80.2	**%RH Max**	84	**DP°F Max**	72.6

Breakers- Dining Room

The Preservation Society of Newport County

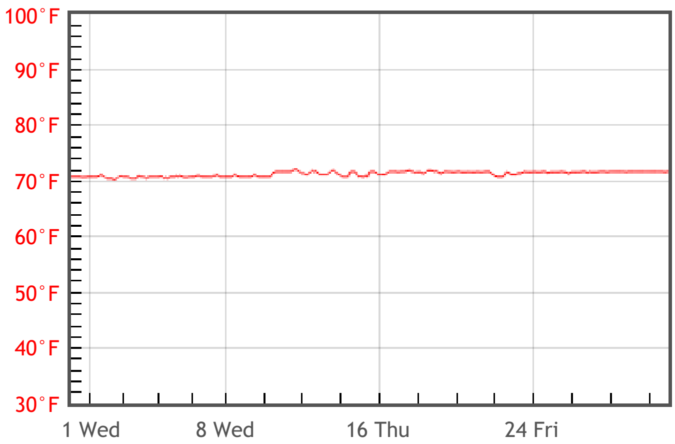
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

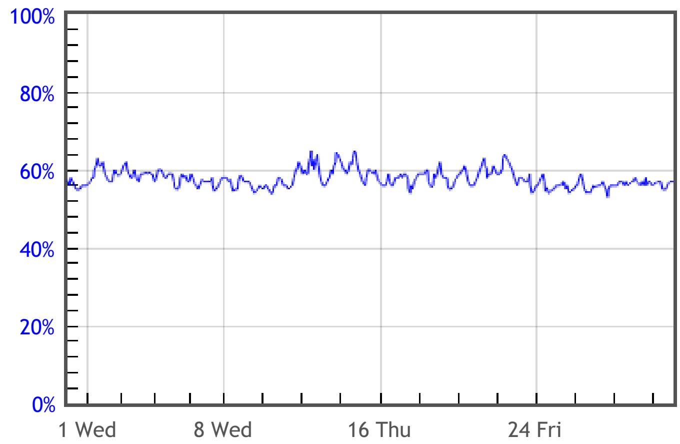
Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 28	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 10.6 % EMC max = 10.6	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 10.6	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs

Temperature °F



Relative Humidity % RH



Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	71.3	**%RH Mean**	58	**DP°F Mean**	55.6
T°F Median	71.4	**%RH Median**	57	**DP°F Median**	55.3
T°F Stdev	0.4	**%RH Stdev**	2	**DP°F Stdev**	1.1
T°F Min	70.3	**%RH Min**	53	**DP°F Min**	53.3
T°F Max	72.1	**%RH Max**	65	**DP°F Max**	59.5

Breakers- Guest Room #10

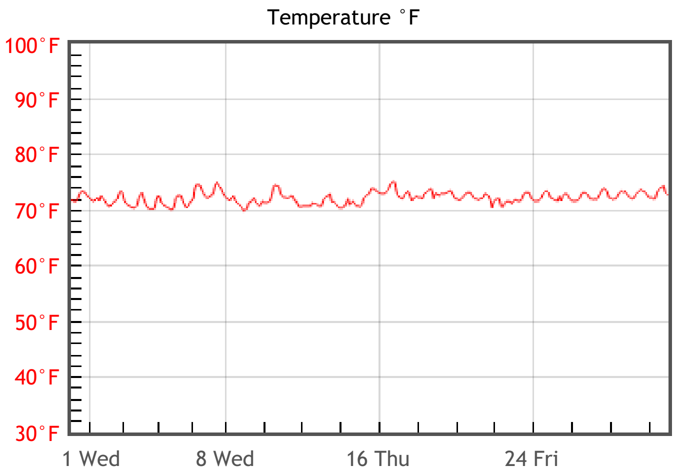
The Preservation Society of Newport County

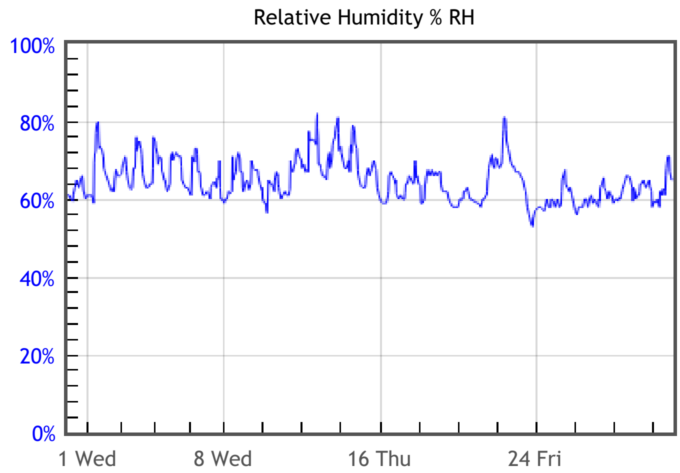
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 22	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 11.9 % EMC max = 11.9	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.13	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 11.9	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	72.2	**%RH Mean**	65	**DP°F Mean**	59.5
T°F Median	72.3	**%RH Median**	64	**DP°F Median**	59.3
T°F Stdev	1.1	**%RH Stdev**	5	**DP°F Stdev**	2.3
T°F Min	69.9	**%RH Min**	53	**DP°F Min**	54.7
T°F Max	75.2	**%RH Max**	82	**DP°F Max**	66.6

Breakers- Ladies Reception Room

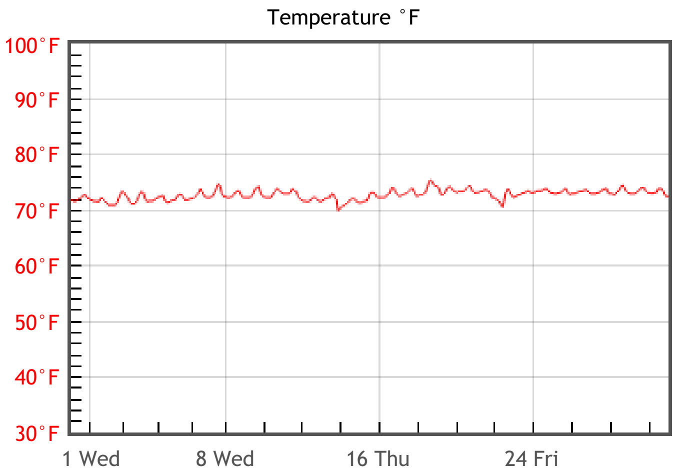
The Preservation Society of Newport County

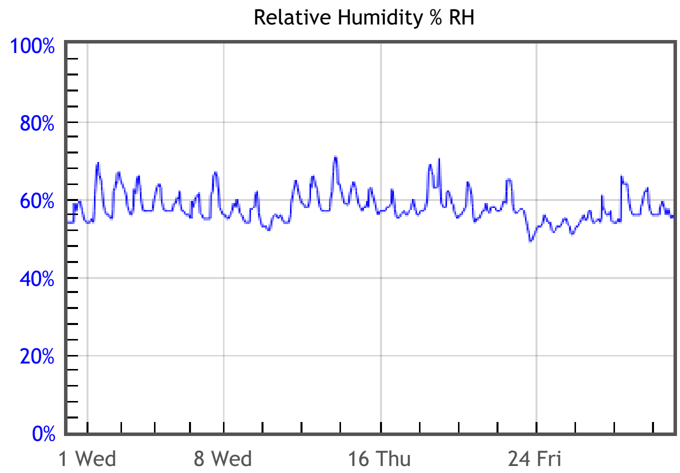
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 25	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 10.5 % EMC max = 10.5	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 10.5	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	72.8	**%RH Mean**	58	**DP°F Mean**	57
T°F Median	73	**%RH Median**	57	**DP°F Median**	56.5
T°F Stdev	0.9	**%RH Stdev**	4	**DP°F Stdev**	2.1
T°F Min	69.9	**%RH Min**	49	**DP°F Min**	53.1
T°F Max	75.5	**%RH Max**	74	**DP°F Max**	64.6

Breakers- Library

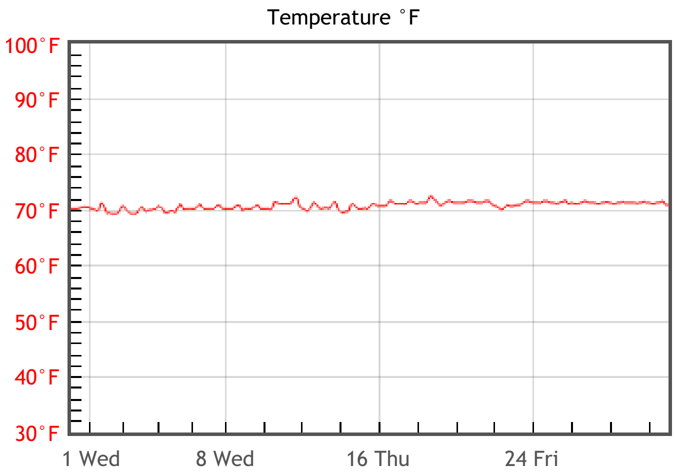
The Preservation Society of Newport County

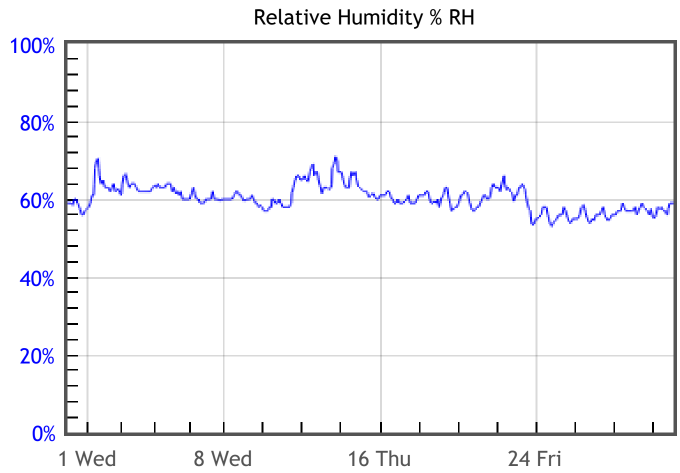
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 27	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 10.9 % EMC max = 10.9	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 10.9	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	70.9	**%RH Mean**	60	**DP°F Mean**	56.4
T°F Median	71	**%RH Median**	60	**DP°F Median**	56.3
T°F Stdev	0.6	**%RH Stdev**	3	**DP°F Stdev**	1.4
T°F Min	69.4	**%RH Min**	53	**DP°F Min**	53.2
T°F Max	72.6	**%RH Max**	73	**DP°F Max**	62.3

Breakers- Mr. Vanderbilt's bedroom

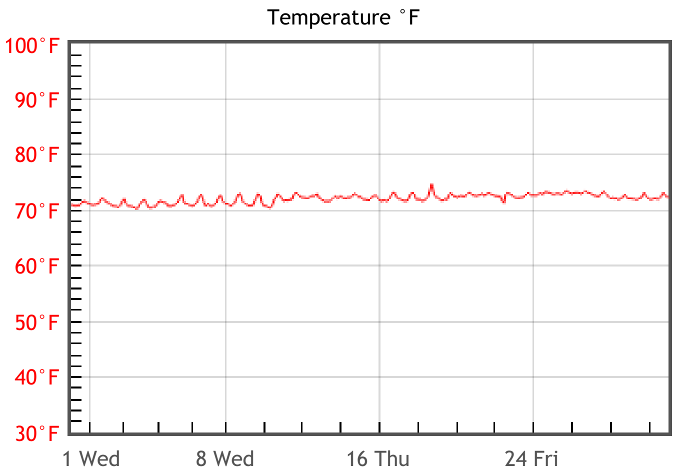
The Preservation Society of Newport County

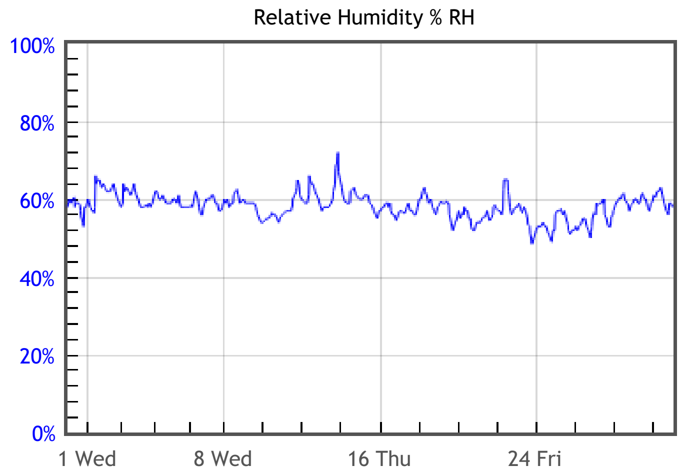
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 26	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 10.6 % EMC max = 10.6	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 10.6	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	72.1	**%RH Mean**	58	**DP°F Mean**	56.6
T°F Median	72.3	**%RH Median**	58	**DP°F Median**	56.5
T°F Stdev	0.8	**%RH Stdev**	3	**DP°F Stdev**	1.4
T°F Min	70.3	**%RH Min**	48	**DP°F Min**	51.8
T°F Max	74.8	**%RH Max**	72	**DP°F Max**	62.6

Breakers- Mrs. Vanderbilt's bathroom

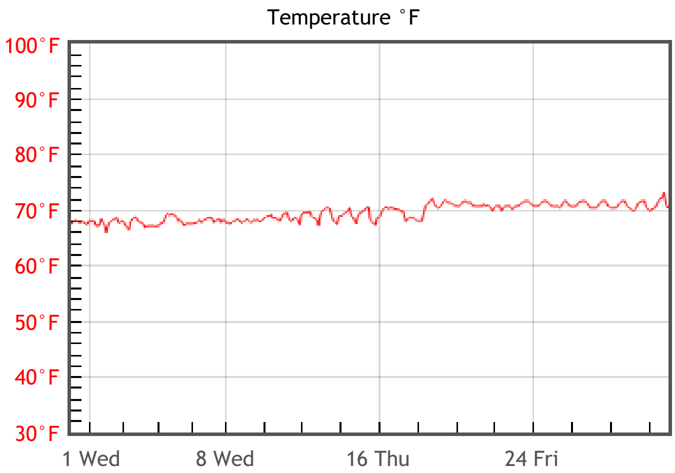
The Preservation Society of Newport County

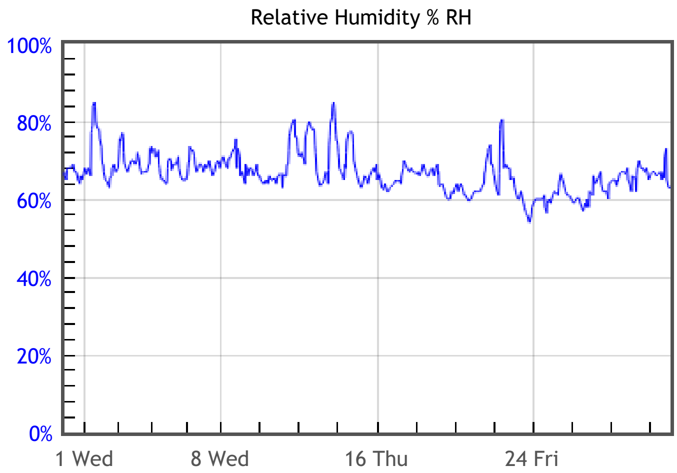
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 24	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 12.4 % EMC max = 12.4	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.22	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.4	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	69.5	**%RH Mean**	67	**DP°F Mean**	57.9
T°F Median	69.6	**%RH Median**	66	**DP°F Median**	57.5
T°F Stdev	1.5	**%RH Stdev**	5	**DP°F Stdev**	1.8
T°F Min	66	**%RH Min**	54	**DP°F Min**	53.9
T°F Max	73.2	**%RH Max**	86	**DP°F Max**	65.9

Breakers- Mrs. Vanderbilt's bedroom

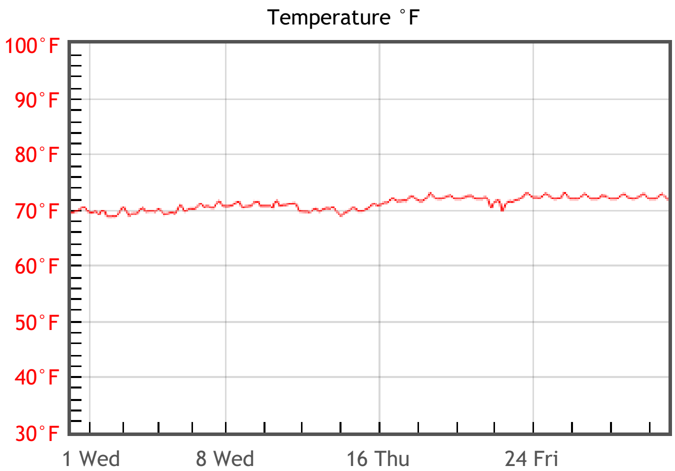
The Preservation Society of Newport County

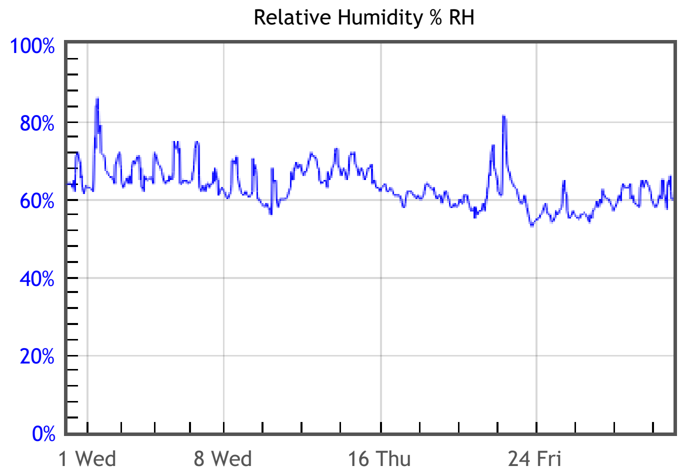
2018-07-31 to 2018-08-30
1 month

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 24	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	GOOD % DC = 0 % EMC min = 11.5 % EMC max = 11.5	Minimal risk of physical damage to most hygroscopic materials such as paintings, rare books and furniture.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.09	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 11.5	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	71.2	**%RH Mean**	63	**DP°F Mean**	58
T°F Median	71.2	**%RH Median**	63	**DP°F Median**	57.7
T°F Stdev	1.1	**%RH Stdev**	5	**DP°F Stdev**	1.8
T°F Min	68.9	**%RH Min**	52	**DP°F Min**	53.9
T°F Max	73.2	**%RH Max**	86	**DP°F Max**	65.7

Breakers- Dining Room

The Preservation Society of Newport County

2017-09-01 to 2017-11-30
3 months

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 26	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.89 % EMC min = 11.3 % EMC max = 14.5	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 1.37	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 14.5	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs

Temperature °F

Relative Humidity % RH

Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	67.7	**%RH Mean**	68	**DP°F Mean**	56.7
T°F Median	67.8	**%RH Median**	67	**DP°F Median**	56.9
T°F Stdev	3.5	**%RH Stdev**	10	**DP°F Stdev**	6.7
T°F Min	60.9	**%RH Min**	42	**DP°F Min**	43
T°F Max	73.2	**%RH Max**	89	**DP°F Max**	69.6

Breakers- Guest Room #10

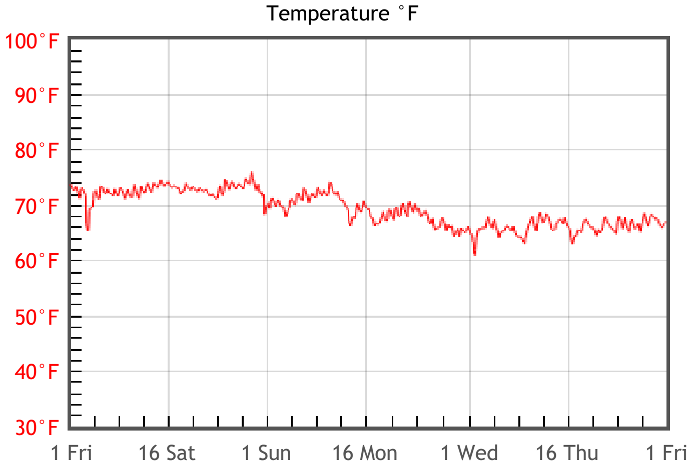
The Preservation Society of Newport County

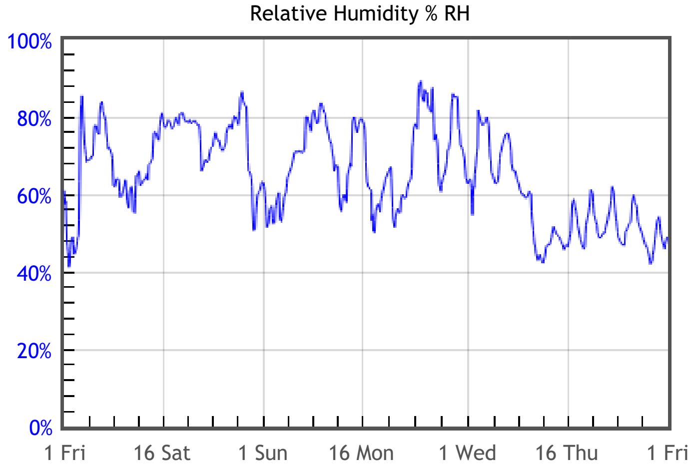
2017-09-01 to 2017-11-30
3 months

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 25	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.94 % EMC min = 10.3 % EMC max = 13.6	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 1.28	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 13.6	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	69.3	%RH Mean	65	DP°F Mean	56.6
T°F Median	69	%RH Median	65	DP°F Median	56.9
T°F Stdev	3.2	%RH Stdev	12	DP°F Stdev	7
T°F Min	60.8	%RH Min	39	DP°F Min	42.4
T°F Max	76.6	%RH Max	90	DP°F Max	70.9

Breakers- Ladies Reception Room

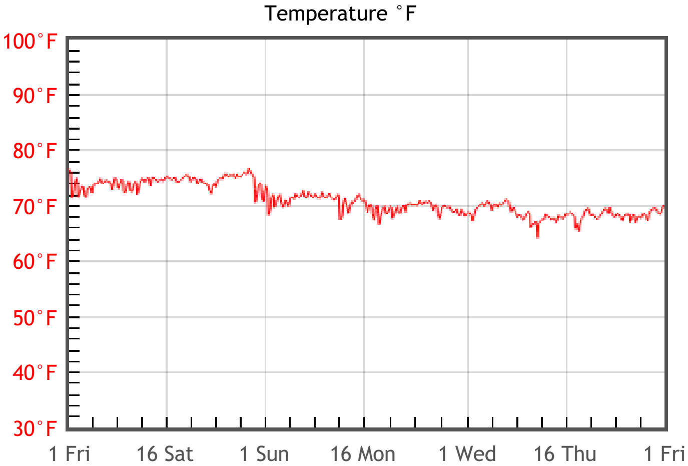
The Preservation Society of Newport County

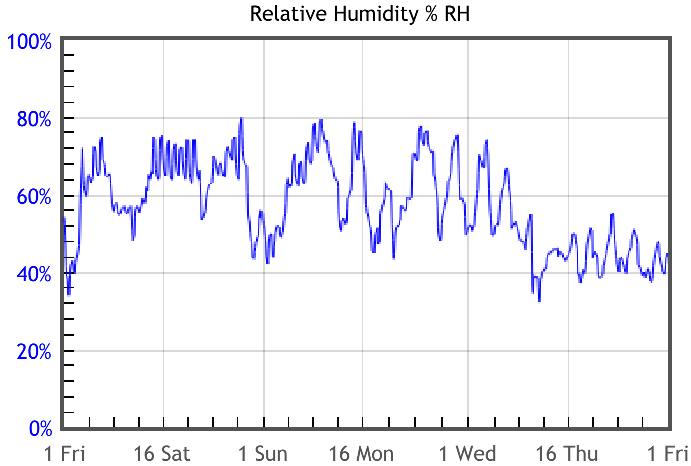
2017-09-01 to 2017-11-30
3 months

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 27	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	OK % DC = 0.79 % EMC min = 8.9 % EMC max = 11.8	Generally OK, but sensitive or fast responding hygroscopic materials such as paintings, rare books, vellum manuscripts or musical instruments will be at elevated risk of physical damage due to fluctuations of humidity.
Mold Risk Mold growth in area or on collection objects	GOOD MRF = 0.38	Minimal risk of mold growth.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 11.8	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	71	**%RH Mean**	57	**DP°F Mean**	54.7
T°F Median	70.5	**%RH Median**	57	**DP°F Median**	55.3
T°F Stdev	2.7	**%RH Stdev**	11	**DP°F Stdev**	7.4
T°F Min	61.5	**%RH Min**	30	**DP°F Min**	32.1
T°F Max	76.8	**%RH Max**	81	**DP°F Max**	70.1

Breakers- Library
The Preservation Society of Newport County

2017-09-01 to 2017-11-30
3 months

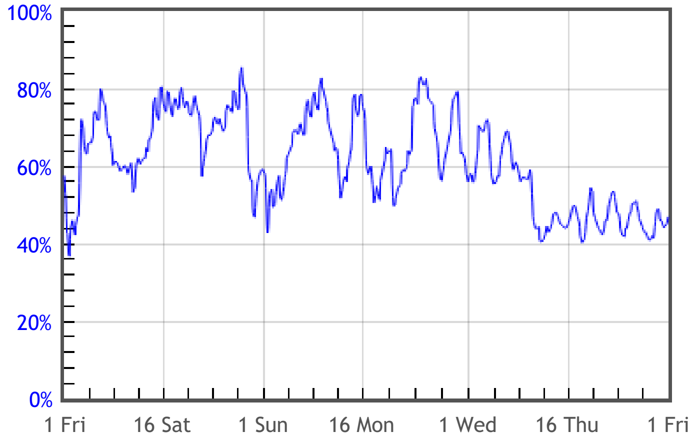
Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 25	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.97 % EMC min = 9.4 % EMC max = 12.9	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 1.02	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.9	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs

Temperature °F

Relative Humidity % RH



Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	70.5	**%RH Mean**	61	**DP°F Mean**	56.1
T°F Median	70.3	**%RH Median**	61	**DP°F Median**	56.6
T°F Stdev	2.7	**%RH Stdev**	12	**DP°F Stdev**	7.3
T°F Min	64	**%RH Min**	33	**DP°F Min**	39.3
T°F Max	76.8	**%RH Max**	86	**DP°F Max**	71

Breakers- Mr. Vanderbilt's bedroom

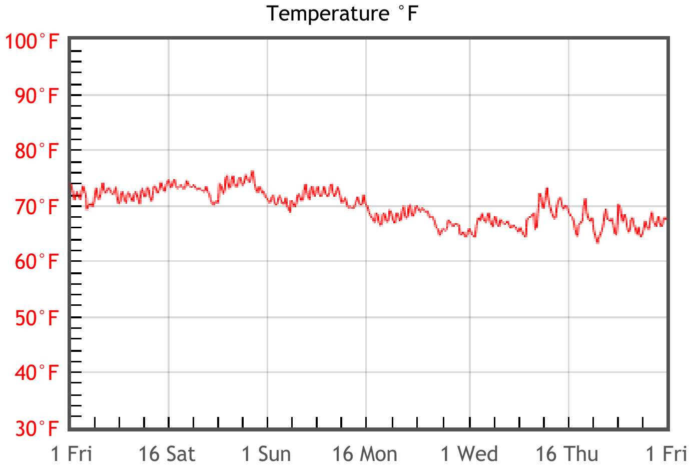
The Preservation Society of Newport County

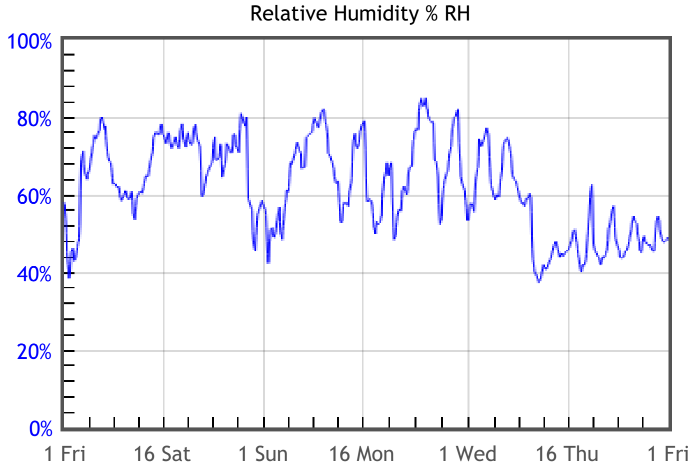
2017-09-01 to 2017-11-30
3 months

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 26	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.8 % EMC min = 9.8 % EMC max = 12.7	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 1.05	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.7	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	69.9	**%RH Mean**	62	**DP°F Mean**	55.7
T°F Median	70.1	**%RH Median**	62	**DP°F Median**	56.1
T°F Stdev	3	**%RH Stdev**	12	**DP°F Stdev**	7.1
T°F Min	62.7	**%RH Min**	36	**DP°F Min**	38
T°F Max	81.3	**%RH Max**	85	**DP°F Max**	70.4

Breakers- Mrs. Vanderbilt's bathroom

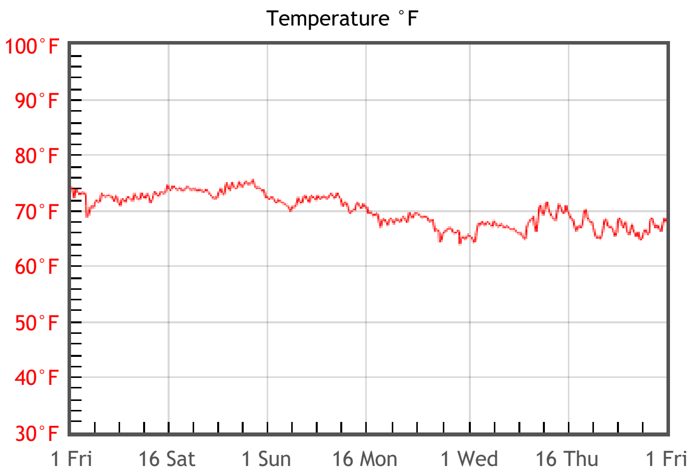
The Preservation Society of Newport County

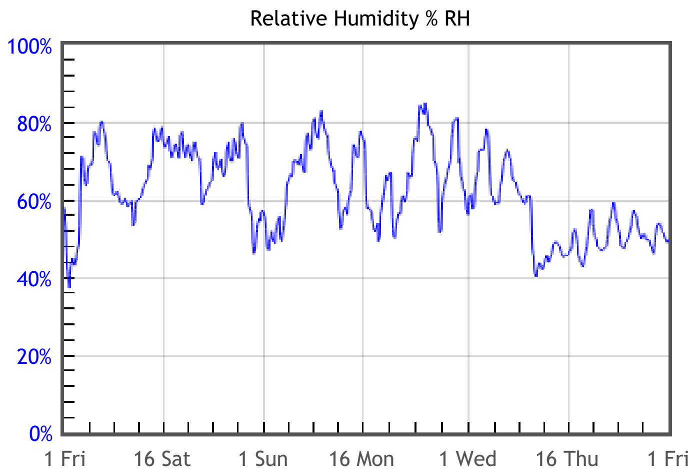
2017-09-01 to 2017-11-30
3 months

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 26	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.76 % EMC min = 9.9 % EMC max = 12.7	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 1.01	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.7	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	70.1	**%RH Mean**	62	**DP°F Mean**	56.1
T°F Median	70.3	**%RH Median**	62	**DP°F Median**	56.3
T°F Stdev	2.9	**%RH Stdev**	11	**DP°F Stdev**	6.5
T°F Min	62.4	**%RH Min**	35	**DP°F Min**	41.2
T°F Max	75.9	**%RH Max**	86	**DP°F Max**	69.4

Breakers- Mrs. Vanderbilt's bedroom

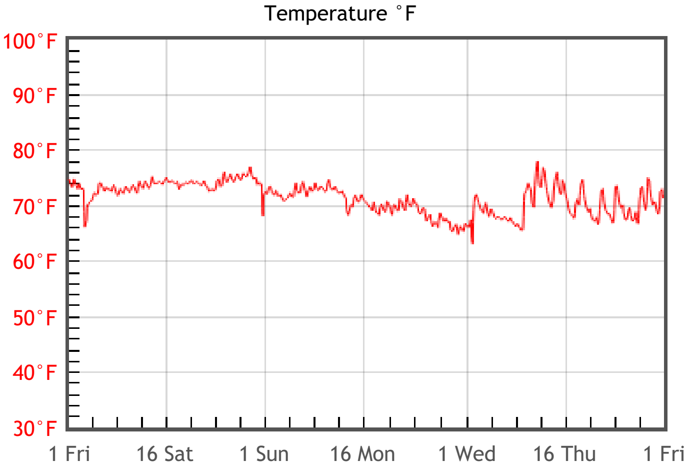
The Preservation Society of Newport County

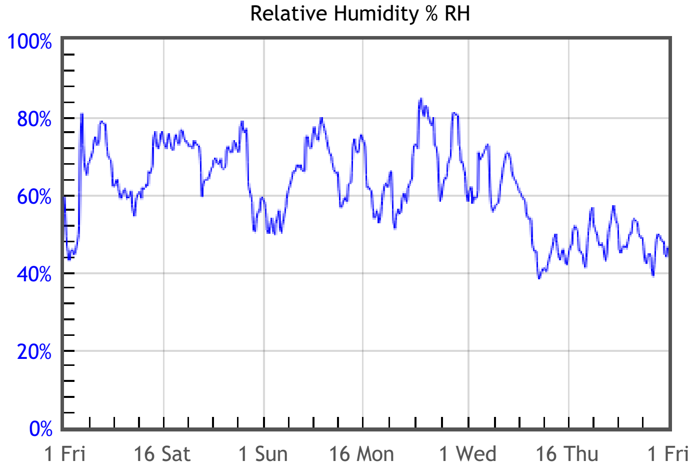
2017-09-01 to 2017-11-30
3 months

Preservation Environment Evaluation

Type of Decay	Risks & Metrics	Evaluation & General Comments
Natural Aging Chemical decay of organic materials	RISK TWPI = 24	Accelerated rate of chemical decay in all organic materials due to the cumulative effects of temperature and humidity, with especially high risk for fast decaying organic materials such as acidic paper, color photographs and cellulosic plastics.
Mechanical Damage Physical damage to hygroscopic materials	RISK % DC = 0.86 % EMC min = 9.5 % EMC max = 12.6	Heightened risk of physical damage to any hygroscopic material, such as paintings, rare books, furniture, paper, leather, film, or color photos, due to extremely low or high levels of humidity, and / or excessive humidity fluctuation.
Mold Risk Mold growth in area or on collection objects	RISK MRF = 0.88	Heightened risk of mold growth due to extended periods of high humidity.
Metal Corrosion Corrosion of metal components or objects	RISK % EMC max = 12.6	Heightened risk of metal corrosion due to extended periods of high levels of humidity.

Graphs





Statistics

Temperature		Relative Humidity		Dew Point	
T°F Mean	71.4	**%RH Mean**	62	**DP°F Mean**	57.1
T°F Median	72.1	**%RH Median**	62	**DP°F Median**	57.1
T°F Stdev	2.8	**%RH Stdev**	11	**DP°F Stdev**	5.8
T°F Min	62.4	**%RH Min**	38	**DP°F Min**	45.8
T°F Max	78.6	**%RH Max**	86	**DP°F Max**	70.1

ATTACHMENT B

Publicity

Breakers awarded $300,000 grant for humidity control

By Sean Flynn
Staff writer

Dave Hansen | Staff photos

From left, Preservation Society of Newport County Executive Director Trudy Coxe and Properties Director Curt Genga talk with William Adams, chairman of the National Endowment for the Humanities, during a visit to The Breakers on Wednesday in Newport. The endowment recently awarded the Preservation Society a $300,000 grant to assist in funding the installation of a ground-source geothermal climate control system at the mansion.

NEWPORT — William Adams, chairman of the National Endowment for the Humanities, stood on the roof of The Breakers on Wednesday afternoon with the sweep of the Cliff Walk below him, from Doris Duke's Rough Point to the south to Easton's Beach to the north.

He made his first visit to the city to announce approval of a $300,000 grant to the Preservation Society of Newport County to help pay for the installation of a ground-source geothermal system that will control the level of humidity inside The Breakers. The system will help preserve the more than 3,000 art works, furniture and artifacts inside the grandest of Newport's summer "cottages."

"I'm very impressed by the scope of this historic site and its setting," Adams said. "It's virtually the whole community. The town has a rich history, not only from the Gilded Age era, but also from colonial America. We're very proud of this grant. It's a small piece of an ongoing conservation project for the Preservation Society and the entire community."

Adams was given a complete tour of The Breakers, from the basement through all four floors, including the attic, to the roof. He was accompanied by Trudy Coxe, the society's executive director, and society staff including Curt Genga, director of properties; Katherine Long, the grant writer who wrote the application; and Maureen Sheridan, director of development.

"You can't imagine how important this project is," Coxe told Adams.

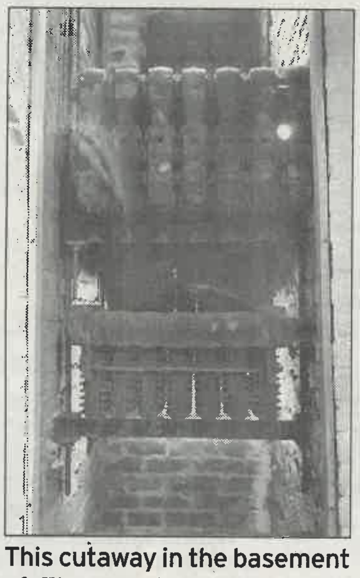
The Breakers overlooks the coast and is subject to alternately dry and humid winters, as well as the hot humid summers. The humidity level was over 90 percent on Tuesday, Genga said.

"Many of the important architectural surfaces and movable collections within The Breakers are fragile and extreme fluctuations of relative humidity in particular are threatening the delicate architectural treatments and important fine and decorative arts objects," the society wrote in its grant application. "The most significant outcome of the project will be a major improvement in interior relative humidity, preventing further deterioration of the collections."

Controlling the humidity in a mansion that has more than 138,000 square feet of interior space — almost an acre on each of the three main floors — is a major challenge.

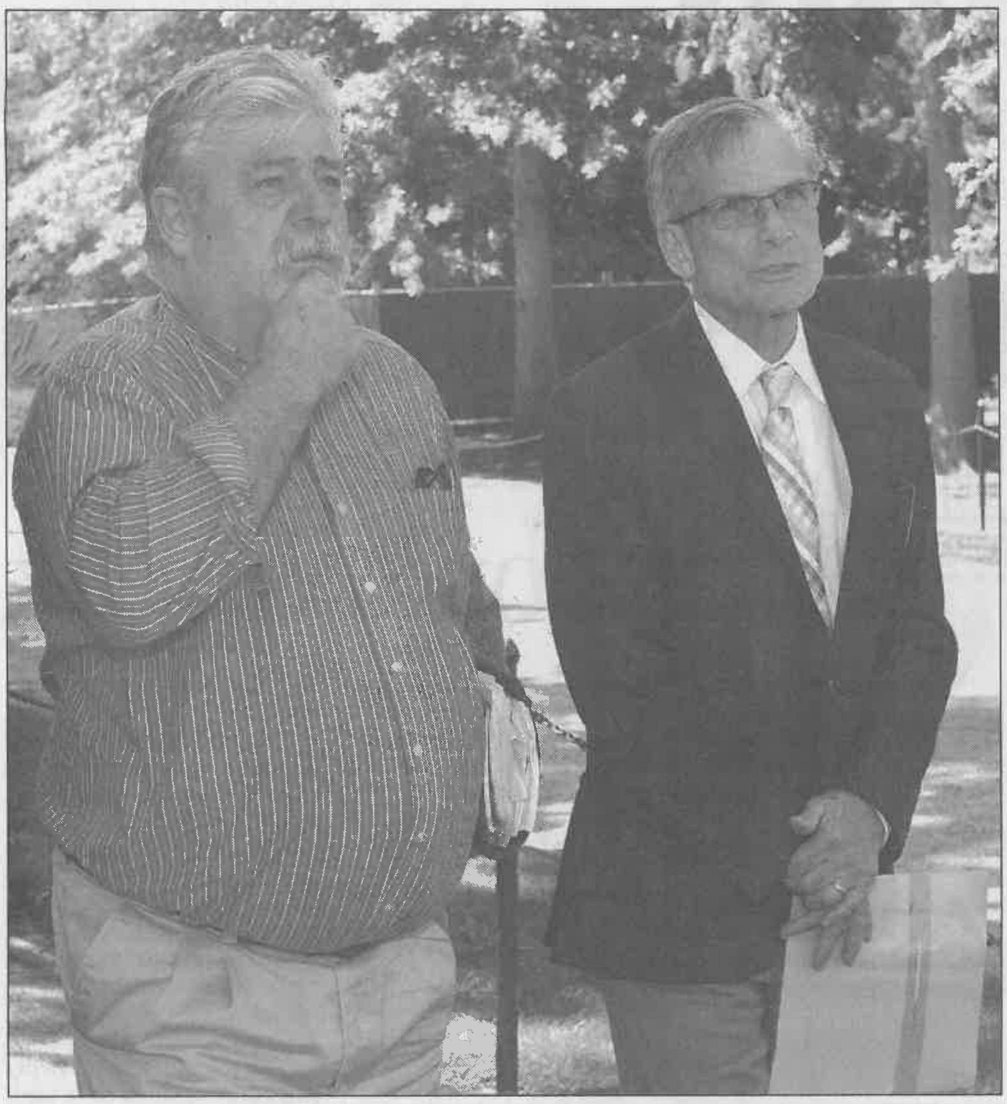
The planning for the system began more than 10 years ago. A 2011 planning grant from the National Endowment for the Humanities program called "Sustaining Cultural and Heritage Collections" paid for a feasibility

BREAKERS A5



This cutaway in the basement of The Breakers shows one of the 36 heating chambers with cast-iron radiators.

Preservation Society Properties Director Curt Genga, right, talks with William Adams, chairman of the National Endowment for the Humanities, on Wednesday at The Breakers.



Dave Hansen | Staff photographer

Preservation Society of Newport County Properties Director Curt Genga, left, talks with William Adams, chairman of the National Endowment for the Humanities, during a visit to The Breakers on Wednesday in Newport.

Breakers

Continued from A3

study that set the stage for the design. A Loeb Family Foundation grant paid for the pilot project that showed the design was viable.

The humidity control system is still being engineered, but preliminary estimates put the total cost in the range of $700,000 or higher, Genga said. He explained in detail how the design will use the infrastructure of the historic mansion.

Commodore Cornelius Vanderbilt, who lived from 1794 to 1877, established the family fortune in steamships and later in the New York Central Railroad. His grandson, Cornelius Vanderbilt II, became chairman and president of the railroad in 1885, and purchased a wood-framed house called The Breakers here that same year. In 1893, he commissioned architect Richard Morris Hunt to design a villa to replace the earlier house, which was destroyed by fire the previous year. Hunt created a 70-room Italian Renaissance-style palazzo inspired by the 16th-century palaces of Genoa and Turin.

The mansion was built with 36 chimneys, which had radiators fed by coal-fired boilers to heat the air pumped into the many rooms, Genga said. In the summer, cool air coming off the ocean went into the subterranean basement before it was pumped into the rooms, providing relief from the heat. The new closed-loop humidity control system will keep this design, but use condensers to keep the humidity at a steady 50 percent to 55 percent, he said. The air will go through ultraviolet light to kill all bacteria.

The most humid room in the mansion was Vanderbilt's bedroom in the southwest corner on the second floor, Genga said. The pilot project successfully took on this room to control the humidity.

"We want the most efficient system we can get," Genga said. "The technology keeps getting better each year."

Installation of a traditional heating, air conditioning and ventilation system would have been too costly, Coxe said. The mansion is now heated by no. 2 heating oil, requiring about 30,000 gallons a year at a total cost of about $100,000 a year.

The Vanderbilts had seven children. Their youngest daughter, Gladys, who married Count Laszlo Szechenyi of Hungary, inherited the house on her mother's death in 1934. She opened The Breakers in 1948 to raise funds for the Preservation Society. In 1972, the Preservation Society purchased the house from her heirs.

The federal government designated the mansion a National Historic Landmark in October 1994 and previously designated The Breakers and the surrounding area a National Historic Landmark District in May 1976.

The National Endowment for the Humanities was created as an independent federal agency in 1965 and will celebrate its 50th anniversary in September this year, said Theola DeBose, NEH's director of communications and who participated in the tour. The agency is one of the largest funders of humanities programs in the country and it makes grants to cultural institutions, such as museums, archives, libraries, colleges and universities.

"We are committed to preserving the legacy of this important historic site for the American people," Adams said during the Breakers tour. "The more than 400,000 national and international visitors who come here each year is testimony to its great appeal."

Flynn@NewportRI.com

Kayla Ebner | Staff photos

Brian Lawrence supervises the progress of a drill at The Breakers in Newport.

Cooler & warmer

Geothermal system comes to The Breakers

By Sean Flynn
Staff writer

NEWPORT — Workers at The Breakers this week began drilling a total of 75 holes into the ground, each 110 feet deep, representing the first steps of installing a geothermal system that will heat and cool the mansion.

The ground temperature deep down is 52 to 55 degrees all year round, which gives a geothermal system a headstart no matter what the season is. The temperature just has to be boosted 12 to 15 degrees to get to room temperatures in the winter, and the temperature is great for cooling in the summer.

Two copper tubes will be inserted down to the depths of each of the 75 holes and then will lead underground under the back patio of the mansion to connect to 16 heat pumps, which can operate in reverse to cool, and to condensers that will keep the humidity of the air inside the mansion at a steady 55 percent all year round.

Curt Genga, the Preservation Society's director of properties, and Andrea Carneiro, the society's communications manager, gave visitors a tour of the work underway this week, and showed how the existing infrastructure of the huge mansion will be used for the geothermal system, making construction changes inside the mansion unnecessary.

There are 70 large chimney shafts inside the mansion that connect the basement to the many rooms above. The geothermal system will be using 36 of those shafts. Air will be heated or cooled, dehumidified, and pumped into air ducts leading to the rooms through the shafts.

The principal of the system is simple, the way Genga explained it. Hot summer air from the mansion goes down into the ground to get chilled, or cold winter air from the mansion goes down into the ground to get warmed up.

Puron is the refrigerant used in the copper tubes connected to the heat pumps and condensers. Since it's a refrigerant system, there's no water involved, Genga said. Copper is a great conductor, 400 times more effective than plastic or other materials, according to the firm that manufactures the system's components.

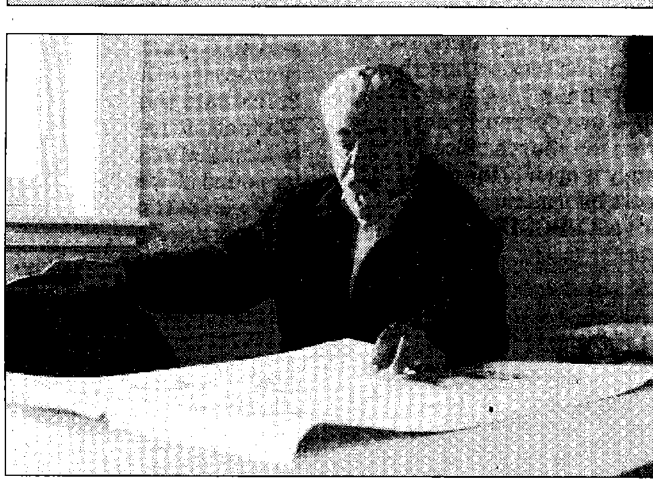
Installation of a traditional heating, air conditioning and ventilation system would have been much too costly. The mansion is now heated by No. 2 heating oil, requiring up to 30,000 gallons a year. When the price of heating fuel was over $3 a gallon, that led to heating costs of about $100,000 a year.

With the geothermal system, the furnace would only be used if temperatures drop below 0 degrees, which is seldom now, Genga said.

Ground source heat pumps have the lowest environmental impact of all heating systems, according to the federal Environmental Protection Agency and Department of Energy.

With the low-voltage heat pump, one watt of electricity converts to the equivalent of four watts of heat, Genga said.

The geothermal system was purchased from Earthlinked Technologies of Lakeland, Florida. Lawrence Air Systems of Barrington is installing the system, while Maine Drilling of Milford, Massachusetts, is the subcontractor drilling the holes.



Curt Genga, above, properties director for the Preservation Society of Newport County, explains the work being done at The Breakers. At top, Wyatt Wunderlich finishes up with one of the holes that was drilled recently as part of the new geothermal system.

BREAKERS A4

Breakers

Continued from A3

It can take about 40 minutes to drill down 110 feet and most of that is through solid rock. The drill bits have to be switched out continuously — it takes eight or nine drill bits to get all the way down, explained Brian Lawrence, co-owner of the company overseeing the project.

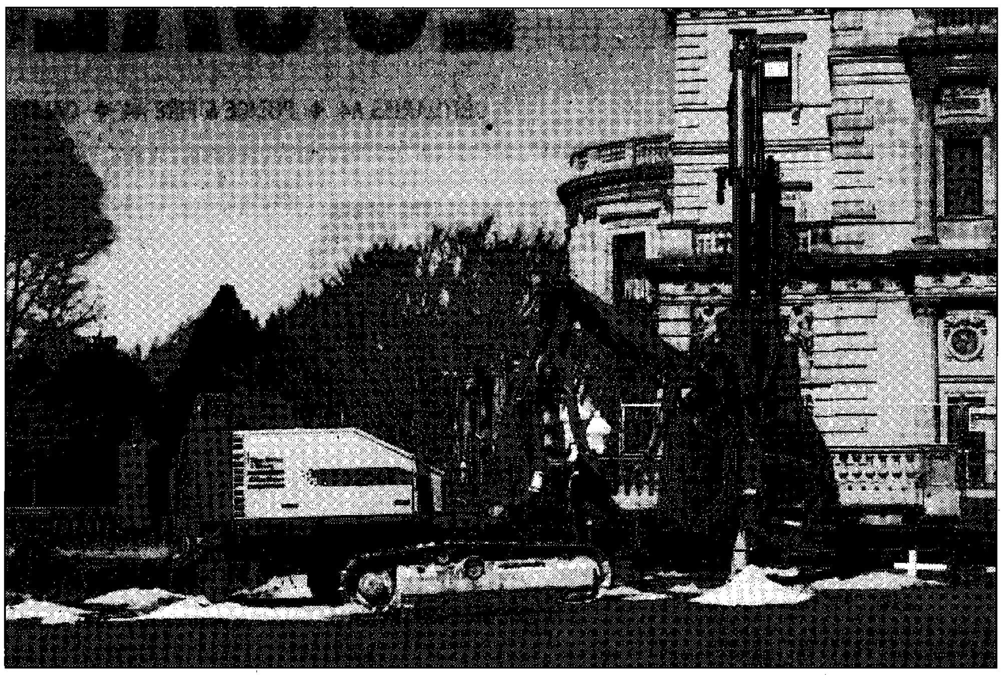
The installation of the geothermal system represents a $950,000 investment by the Preservation Society, well below the original estimate of $1.3 million.

"We are always working on pricing," Genga said. "The equipment gets more efficient every year. This wasn't feasible four or five years ago."

The contractors expect to be done with the drilling in April and then will start putting the copper lines from the wells into the building. The system could be operational in August or September, Genga said.

A new ultraviolet film will be put on the mansion's windows on the south and east sides to reflect the sun's heat, a measure that will help keep temperatures steady inside the mansion.

Controlling the humidity in a mansion that has more than 138,000 square feet of interior space — almost an acre on each of the three main floors — is a major challenge. The geothermal system will serve the two main floors that house the showrooms and the exhibits.



Kayla Ebner | Staff photographer

Construction on a new geothermal system at The Breakers began recently, and each hole takes around 40 minutes to drill.

Many of the important architectural surfaces and movable collections within The Breakers are fragile and fluctuations of relative humidity are threatening to them, Genga and Carneiro said.

Cornelius Vanderbilt II, who became chairman and president of the New York Central Railroad in 1885, purchased a wood-framed house called The Breakers here that same year. After that home was destroyed by fire, Vanderbilt in 1893 commissioned architect Richard Morris Hunt to design the existing 70-room Italian Renaissance-style palazzo inspired by 16th-century palaces of Genoa and Turin.

There are more than 3,000 artworks, furniture and artifacts inside the grandest of Newport's summer "cottages" and keeping the humidity steady will prevent deterioration of this great collection, according to the Preservation Society.

The planning for the geothermal system began almost 12 years ago, Genga said. He worked on plans with Jeff Moore, the society's previous conservator, and Bill Wlaydka, the society's engineer for the project.

Geothermal systems also have been installed at the Preservation Society's Chepstow mansion and the Carriage House of the Elms. The society owns 11 mansions and homes that are open to the public.

"We'd like to do this at all the Preservation Society houses," Carneiro said. "Once it's in the ground and operating, it eliminates a lot of fuel dollars."

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PROVIDENCE BUSINESS NEWS

APRIL 28–MAY 4, 2017

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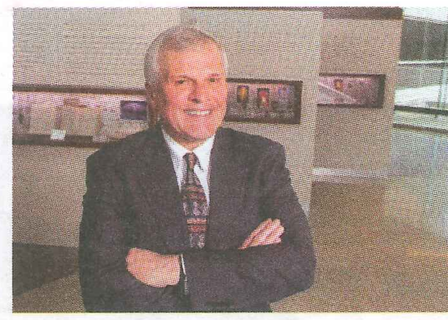

SPECIAL SECTION: PBN'S 2017 C-SUITE AWARDS INSIDE

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SPOTLIGHT

IN THE LOOP: Lawrence Air Systems Inc. co-owner Brian Lawrence, left, and employee Jim Fulton install a ground loop for a geothermal system at The Breakers in Newport.
PBN PHOTO/KATE WHITNEY LUCEY

Energizing historic homes

Geothermal systems in demand

BY EMILY GOWDEY-BACKUS | Gowdey-Backus@PBN.com

LAWRENCE AIR SYSTEMS INC., SPECIALIZES IN modernizing the heating and cooling capabilities of Rhode Island's many historic homes and properties, says co-owner Brian Lawrence.

"I personally enjoy trying to figure out how the existing system can be adapted" to work with new technology, said Lawrence.

Headquartered in Seekonk, the second-generation family business provides air conditioning, heating, geothermal ventilation and high-efficiency equipment repair and replacement services. While the company performs most of its business on the eastern side of Rhode Island, Lawrence said they have traveled as far as Cape Cod.

In 2007, after 34 years at the helm, founder John Lawrence retired and passed the company to his three sons – Brian, Jason and Aaron.

Since 2005 Lawrence Air Systems has installed Earth Linked Technologies geothermal heating and cooling systems. The Lakeland, Fla.-based company designed a system of 100-foot ground loops, small holes drilled into a home's yard and plugged with heat-conductive copper piping, which transports geothermal energy to a pump that circulates the heated or cooled air into the home.

He said installations he has managed ranged from two to 75 ground loops, depending on the amount of heat needed and size of the facility.

In many cases, the company works within an older home's existing ventilation infrastructure, said Lawrence, who explained about 60 percent of his business is installing geothermal systems in Victorian homes "that are deemed not capable of having [conventional] air conditioning or heating."

In 12 years, Lawrence estimated he has installed between 120-150 geothermal systems.

He acknowledged there are certain scenarios – such as older downtown homes with little to no yard – where geothermal systems won't work.

The company is nearing completion of a $1.3 million, 75-ground-loop install at The Breakers in Newport in March to help preserve both the 19th-century mansion and the artifacts within.

While the system makes the facility more sustainable, Lawrence said: "It's honestly not for the tourists, it's for the property. … If we can preserve [it] and not have anybody see the system, that's our goal."

Curtis Genga, director of properties for the Preservation Society of Newport County, said summer humidity levels inside the mansion consistently hit 80 percent. Without the ability to use conventional dehumidifiers to preserve items such as a 13th-century tapestry, Genga said Earth Linked technology was "exactly what I was looking for."

In addition, post-installation costs to heat The Breakers will fall to as low as $1,000 – a fraction of the prior annual bill that could reach $90,000 – as the furnace will only kick on in colder months, said Genga. ■

OWNERS: Brian, Jason and Aaron Lawrence

TYPE OF BUSINESS: Heating and cooling mechanical contractor

LOCATION: 1590 Fall River Ave., Seekonk

EMPLOYEES: 14 full time

YEAR ESTABLISHED: 1973

ANNUAL SALES: WND

Cool: Historic Newport Mansion Goes Geothermal

September 13, 2018

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The Breakers traditionally consumed 20,000 gallons of oil annually for heating. (istock)

By ecoRI News staff

NEWPORT, R.I. — The Preservation Society of Newport County has stabilized humidity in a large-scale historic structure and reduced the building's carbon footprint with the installation of a ground-source geothermal system at The Breakers.

The system combines 19th-century engineering and 21st-century technology to create an interior climate conducive to protecting and preserving the mansion's collections.

The new system, which uses historic heating shafts built into the masonry of the building in the 1890s to circulate modified air to targeted areas, has proven a significant success, according to Trudy Coxe, executive director of The Preservation Society of Newport County.

Despite record-breaking heat and humidity in Rhode Island this summer, interior humidity and temperatures in The Breakers have remained stable and comfortable, Coxe said. In winter the same geothermal system maintains stable temperatures and humidity with minimum additional heating.

Designed by Richard Morris Hunt for Cornelius Vanderbilt II in 1893 and completed in 1895, The Breakers is a 138,000-square-foot National Historic Landmark. Securing the interior climate of the main house was imperative to the long-term protection of this historic site.

Extreme fluctuations of relative humidity threatened the historic building's architectural finishes and its decorative arts objects. After extensive research and planning, The Preservation Society of Newport County made the decision three years ago to invest in a ground-source geothermal system using 75 in-ground wells with closed-loop piping.

A refrigerant is circulated through the ground, which has a year-round temperature of about 55 degrees Fahrenheit, is warmed, or cooled, to that temperature, and is then used to drive the heating/cooling process in heat pumps.

Historically, The Breakers was heated through the convection of hot air through ducts built into the masonry. The innovation of the geothermal system is its use of the existing infrastructure to supply targeted areas with modified air. Heat pumps supply 15 fan coil units at selected shafts, which condense water out of the supplied air. The dehumidified, chilled, and filtered air travels through ductwork to the shafts above the existing heating coils to supply the rooms.

Return air is delivered back to the fan coils for re-treatment. Since the system design uses the existing infrastructure, there was no need to interfere with the fabric of the building in any significant way, consistent with the secretary of the interior's "Standards for the Treatment of Historic Properties."

Since its completion this spring, the geothermal system has already yielded impressive results, according to Coxe. Relative humidity has been recorded in the correct target zones of 40 percent to 60 percent, with temperatures in the low to mid-70s.

Prior to the geothermal installation, The Breakers traditionally consumed 20,000 gallons of oil annually for heating.

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From the ground up

The heart of the geothermal system is in the basement of the Breakers. The panel has thermostats for each target area and are controlled by facilities using a computer. Behind Kathy Garrett-Cox, the collections manager, are the actual heat exchangers, several of which are located throughout the basement and feed into the historic heating shafts. [PETER SILVIA PHOTOS]

Breakers' new geothermal system helps preserve historic contents

By Laura Damon
Staff writer

NEWPORT — Kathy Garrett-Cox pointed to vents throughout The Breakers on Thursday and snaked her way through the tunnels beneath the house to explain the new geothermal system that will help to preserve the artifacts housed within the Gilded Age mansion.

"Now we're state-of-the-art for 2018," said Garrett-Cox, the collections manager with the Preservation Society of Newport County.

Installed in the spring, the ground-source geothermal system controls the level of humidity in The Breakers, thus protecting the furniture and textiles from damage. Wood expands and retracts with fluctuations of humidity, Garrett-Cox said, and so, though painted gold, the furniture in The Breakers would split and lose its luster with the irregular and intense temperatures.

"They [the artifacts] were really showing their age due to the weather and the climate," said Trudy Coxe, executive director of the Preservation Society, in a phone interview with The Daily News.

To save the artifacts, Preservation Society staff started brainstorming a few years ago to implement a new system that would help with conservation.

The Preservation Society of Newport County has installed a geothermal system that controls temperature and stabilizes humidity to ensure sustainability of its historic collection. Kathy Garrett-Cox, the collections manager, talks about the necessity to protect items in the collection that are vulnerable to humidity.

"In most museums, the goal is to have a consistent humidity level," Coxe said. "We needed to climate-control the building for the sake of the objects in the building."

See BREAKERS, A6

BREAKERS

From Page A1

Not only that: The Breakers tours were often uncomfortably hot in the summer. "It was not the best experience we wanted for our guests," Coxe said. And so, the Preservation Society mobilized to remedy the problem.

The project was funded by grants from various donors, including the National Endowment for the Humanities – which announced a $300,000 grant in 2015 – the Champlin Foundation and Ann and Sam Mencoff.

The new geothermal system cools, but it also heats. Prior to its installation, The Breakers consumed approximately 20,000 gallons of oil annually for heating. Though it cost approximately $700,000, the new geothermal system offers savings in fuel costs and will require less maintenance than traditional air conditioning systems, according to Preservation Society staff.

The beauty of the geothermal system lies not only in its efficiency but its discretion. The character of The Breakers was not compromised in the installation of the system; it builds on the original engineering and architecture of the house.

"It shows that you can climate-control a historic house and you can do it in a way that's very respectful," Coxe said. The Breakers now, with the new system in place, is "exactly the same Breakers that you saw 10 years ago," Coxe said. "When it comes to preservation, that is the goal."

Richard Morris Hunt was commissioned in 1893 by Cornelius Vanderbilt II to create the 70-room Italian Renaissance-style palazzo. The building was heated through the convection of hot air ducts built into the masonry. The new geothermal system uses the traditional infrastructure to supply targeted areas with modified air. With the new system, an environmentally-friendly liquid circulates through a well system made up of 75 in-ground wells; the liquid reaches a temperature of 54 degrees Fahrenheit, consistent with the ground temperature in the well system, and it is modified based on its target room and the humidity level required there.

Curt Genga, former director of properties with the Preservation Society, presided over the design of the new system and contracting. The contractor was Lawrence Air Systems, based in Seekonk, Massachusetts. Jeff Moore, retired chief conservator with the Preservation Society, also had a hand in the project and Properties Director Christopher Daly saw the installation to completion.

Among the society's other historic properties, Chepstow also uses a geothermal system; Hunter House and Kingscote have more traditional air conditioning systems, Garrett-Cox said.

"Since its completion in the spring of 2018, the geothermal system has already yielded remarkable results," according to a prepared statement from the Preservation Society. "Relative humidity has been recorded in the correct target zones of 40-60 [percent] with temperatures in the low- to mid- 70s. The resulting climate is comfortable enough that doors and windows can be kept closed in summer, preserving the stable humidity for the building, protecting its precious collections and improving the climate conditions for the 450,000 guests who visit each year."

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INDEXES ON PAGES 36 & 37

The Preservation Society of Newport County Installs Geothermal System At The Breakers

NEWPORT, R.I. — The Preservation Society of Newport County has achieved the combined goals of stabilizing humidity in a large-scale historic structure and dramatically reducing its carbon footprint with the installation of a ground-source geothermal system at the Breakers, the former Gilded Age "summer cottage" of the Vanderbilt family in Newport, R.I. One of the most ambitious and innovative projects of its kind, this groundbreaking system combines Nineteenth Century engineering and Twenty-First Century technology to create an interior climate conducive to protecting and preserving the house's precious collections.

"This is a major breakthrough in historic preservation because the geothermal system reduces the environmental footprint of the Breakers, thus helping to ensure the long-term sustainability of one of the country's most visited historic sites," said Trudy Coxe, CEO and executive director of the Preservation Society of Newport County. "We are deeply grateful to the many donors who supported this project, led by generous grants from The National Endowment for the Humanities, The Champlin Foundation and Mr and Mrs Samuel M. Mencoff."

The new system, which uses historic heating shafts built into the masonry of the building in the 1890s to circulate modified air to targeted areas, has proven a significant success. Despite record-breaking heat and humidity in Rhode Island this summer, interior humidity and temperatures in the Breakers have remained stable and comfortable. In winter, the same geothermal system maintains stable temperatures and humidity with minimum additional heating.

Extreme fluctuations of relative humidity threatened the historic house's delicate architectural finishes and its fine and decorative arts objects. After extensive research and planning, The Preservation Society of Newport County made the decision three years ago to invest in a state-of-the-art ground-source geothermal system using 75 in-ground wells with closed-loop piping. A refrigerant is circulated through the ground, which has a year-round temperature of about 55 degrees Fahrenheit, is warmed (or cooled) to that temperature and is then used to drive the heating/cooling process in heat pumps.

Historically, the Breakers was heated through the convection of hot air through ducts built into the masonry. The innovation of the geothermal system is its use of the existing infrastructure to supply targeted areas with modified air. Heat pumps supply 15 fan coil units located at selected shafts, which condense water out of the supplied air. The dehumidified, chilled and filtered air travels through ductwork to the shafts above the existing heating coils to supply the rooms. Return air is delivered back to the fan coils for retreatment. Because the system design uses the existing infrastructure, there was no need to interfere with the fabric of the building in any significant way, consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties.

Since its completion in the spring of 2018, the geothermal system has already yielded remarkable results. Relative humidity has been recorded in the correct target zones of 40–60 percent, with temperatures in the low- to mid- 70s. The resulting climate is comfortable enough that doors and windows can be kept closed in summer, preserving the stable humidity for the building, protecting its precious collections and improving the climate conditions for the 450,000 guests who visit each year.

Prior to the geothermal installation, the Breakers traditionally consumed 20,000 gallons of oil annually for heating. The geothermal system offers savings in fuel costs and less maintenance and ensures higher performance that effectively offsets the extra expense of installation.

The Breakers is at 44 Ochre Point Avenue. For information, www.newportmansions.org or 401-847-1000.